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SCIENTIFIC GLOSSARIES IN SIXTEENTH CENTURY ENGLISH BOOKS*

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One of the prime requisites of the scientific literature of any language is an adequate terminology, a particularly important matter when a large body of new knowledge is being brought into a vernacular tongue, as was the case in 16th century England. There was a conscious trend to write of science in English, the great bulk of scientific books being in the English language, rather than in Latin. However, of necessity many of the technical terms were still in Greek or Latin, and there arose the need of accurate definitions.

The earlier Latin-English dictionaries attempted to meet this demand. Thomas Elyot in his *Bibliotheca,* 1538, says that he will give "also the propre termes belongyng to phisike and surgerie, and other divers and sundrie artes and sciences." Thomas Cooper continued this in his enlargement of Elyot's work and in his own *Thesaurus,* 1565. In the latter, one finds many useful definitions, but evidently they were not considered sufficient, for William Turner, one of the great botanists of his day, severely criticizes Cooper and offers some very interesting and practical suggestions.

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Annoyed by his difficulty in finding the right English words in translating certain Greek or Latin terms, he says, in his *A new boke of the natures of all wines,* 1568: in " the great and costlye booke, called *Thesaurus linguae Romanae & Britannicae,* that is, the treasure of the Latin and English tongue . . . in dede as I found great plentie both of good Latin wordes, and fine maners of speaking, gathered wyth great paines, and ordered with no small learning and judgement: but in the English, as I found to much plentie of light, and new inckhorne termes: so in some places I founde such scarcenesse, lacke, and want of proper and true Englishe names, that the author is faine to give one name to diverse Latin wordes, for when I looked how he englished *Acer,* he englisheth it thus. Eger, sharpe, tart, soure or fell. Lo, here is great plentie of wordes, and yet we can not tell what *acer* in taste doth properly signifie . . . Surely we have but small helpe of that booke in declaring of these words, & many such other, that are much occupied in phisicke and philosophy, and in other both liberall and mathematical sciences. Wherfore I wishe, to the ende that the booke may be in dede as it is called: that one learned phisition & philosopher like unto *Linaker,* one olde and learned grammarian like unto *Clemond,* and one perfite Englishman like unto Sir *Thomas Moore,* had the amendment and making perfite of this booke commited unto them." * This would indeed have been an ideal group for such a project.

But there were other scientists who had the same concern and so in a number of scientific works we find glossaries explaining terms used in their own branches of learning. These ranged from quite extensive works of many pages, to those of a few pages or to definitions in the text itself. They cover most of the field of science, but the majority relate to medicine.

Many of the writers—most of them, as is to be expected, translators—give an explanation for these appended glossaries. They say that they are necessary to make the work in question understandable to the unlatined reader. Thus Philemon Holland says in

* $D_4r - D_5r$. In this and in the following quotations the original spelling and punctuation have been retained, except for lengthening of contractions, and modernizing of certain typographical features [s; v and u; i and j]. The titles are given in accordance with the procedure of the *Short-Title Catalogue,* with slight modifications.

the preface to volume II of his translation of Pliny, 1601: "For as much as this second Tome treateth most of Physicke, and the tearms belonging thereto (as well concerning diseases as medecines) be for the most part either borrowed from the Greeke, or, such as the unlearned be not acquainted with, (which partly upon necessitie I was forced, and partly for varietie induced to use) I could not content my self to let them passe without some explanation: For since my purpose especially is to profit and pleasure the most ignorant (for whose sake *Plinie* also himselfe, as he professeth, compiled this worke) I would not bee so injurious unto them as to interrupt their reading with obscuritie of phrase, when the matter otherwise is most familiar." [2]

In his usual delightful dialogue William Bullein has one of his characters, *Sicknes*, say: "There are certain wordes, very harde for me to understand, as when you doe name *Apophlegmatismus, Dropax, Liniment*, etc. I knowe not what thei doe meane, by their proper names: I praie you tell me the significacions." [3] John Halle, the writer, in 1565, of one of the most extensive glossaries, nevertheless has qualms about their necessity and says: "Althoughe it hathe bene the use of authores, to declare in the ende of their bookes, suche strange termes and darke wordes, as maye seme to some obscure: I thinke it should not be nedefull alwaye so to doe, but that ther is such slacknesse in men, and negligence to learne, that they remaine as unperfecte as a dull boye: who for lacke of capacitye coulde never procede farther than his crosse rowe." [4]

But such glossaries were considered valuable throughout the century, and the most important are found in the following works. *The grete herball*, 1526,[1] has at the end, *The exposicyon of the wordes obscure and evyll knowen*. It is quite brief and not very inclusive. The following definitions show how variations in spelling could possibly lead to confusion:

> Litargie or lytarge is a maner of the scomme of metalles.
> Litargie is a dysease also whereof is shewed in Apoplexie.

A colorful definition:

> Mania is a madnesse, as whan it behoveth that the pacient be bound or els he wolde beat every body and breke all things a sonder.

Traheron added to his translation of Vigo, 1543,[2] *The interpretation of straunge wordes used in the translation of Vigon,* about 30 folio pages in length and containing many interesting definitions. His definition of *Terra sigillata* is to be compared with that in Wirsung (q. v):

Terra sigillata.

Terra sigillata is an earth dygged oute of certayne caves in the Isle Lemnos. And bycause it was sent from thence beinge sealed, it was called Sigillata. Some thynke, that we have not the thynge, thoughe we retayne the name.

Antidota

Antidota are medicines to be receyved within the bodye, whereof there bene thre dyfferences. For some are gyven agaynst poyson, some agaynst the styngyng of venemous beastes, or serpentes: and some heale diseases gathered of corrupt meates, and drinkes. They call a boke wherein suche medicynes are descrybed an antidotarie.

Andrew Borde in his *Breuiary of healthe,* 1547,[11] gives the Latin, Greek, occasionally the Arabic, and the English terms for diseases, medicines, etc. in his text. William Bullein has a brief section of the terms in pharmacy in his *Bulwarke of defēce,* 1562.[3] Bullein does not follow the usual alphabetical arrangement.

One large section of John Halle's translation of Lanfranc's *Chirurgerie,* 1565,[4] is *An expositiue Table* of the words, names, and nature of disease and simples in Lanfranc's work. This covers 176 pages and gives very lengthy English definitions of the Latin or Greek terms. The following are interesting examples:

Adustio

Adustion, is as well the burnynge of medicynes, by materialle fire, as of humores in the body, by the excessive distemperature, of potencialle heate therin: Wherof they are called aduste, or burned humores.

Fractura aut restauratio eius

Algebra

This Arabye woorde *Algebra* sygnifyeth as well fractures: (as of bones, etc.) as somtyme the restauratyon of the same.

While all of the foregoing, written incidentally before Turner's statement, were medical, there were no corresponding glossaries for the mathematical sciences, although there are definitions in the works of Recorde,[10] Cuningham,[12] and others. John Dee in his

preface to Billingsley's translation of Euclid, 1570,[5] defines the various mathematical sciences and some of the terms used in them. While not really a glossary, the definitions are an important part of this interesting work, and Dee has inserted a large table giving a schema of the sciences and their definitions. Two of his definitions of branches of science are given as examples. Although they later became common usage, the *New English Dictionary* cites Dee's as the first in English:

> Statike, is an Arte Mathematicall, which demonstrateth the causes of heavynes, and lightnes of all thynges: and of motions and properties, to heavynes and lightnes, belonging.
>
> Thaumaturgike, is that Art Mathematicall, which giveth certaine order to make straunge workes, of the sense to be perceived, and of men greatly to be wondred at.

Mathematical terms are also defined in the works of Digges,[13] Blundeville,[14] and Lucar.[15] Robert Norton's *A mathematicall appendix,* 1604,[9] has at the end *Briefe Expositions of the Geometricall and Astronomicall tearmes mentioned in this Treatise.* Two of his definitions are:

> The Æquator or Æquinoctiall is a great Circle, girding the world in the midst between the two Poles.
>
> The Axis, or axletree of the world, is a lyne supposed to passe through the Centre of the Earth: the extreames or ends of which lyne are the Poles of the world: viz, the North end the Pole artick, and the South end the antartick.

Batman vppon Bartholeme, 1582,[6] contains a *Catalogue of the most hardest olde English words.* Only a few of the terms are scientific.

At the end of the Tudor period there were two works with important glossaries. In Mosan's translation of Wirsung's *Generall practise of physicke,* 1598,[7] there are three indexes. Of these the second and third are glossaries which cover 105 large folio pages. The second index is an alphabetical arrangement of English terms of the substances 'used in Physicke.' Many of the definitions are of considerable length and are interesting in that they often tell of some of the practices of dishonest apothecaries. Good examples of this are the discussions of *sealed earth* and of *mummye*:

Earth sealed, in greeke *Sphragis*, in latine *Terra lemnia, Sigillum lemnium, Lutum lemnium, Rubrica lemnia, Minium lemnium, Lutum sigillatum,* & at the Apothecaries *Terra sigillata*: This earth is marvellously falsified and counterfeited, wherfore great heede must be had in the use of it. Our hedge Phisitions will rather use clay, than want earth in their receipts.

Mummye, *Mumia*: there are two kinds of it, the one is digged out of the Graves in Arabia and Syria of those that are Balsamed, and is brought unto us: it is called *Pissasphaltum factitium*, of the Arabians *Mumia*, at the Apothecaries *Mumia. Serapio* calleth it *Mumia sepulchorum*, to distinguish it from this kinde following. The Phisitions call it *Mumia Arabum* for a difference from *Mumia Graecorum*. The second kind is onely an equall mixture of the Jewes lyme, and *Bitumen*: in Greeke *Pissasphaltum*, in Latine *Picibitumen*, and of the Simplicistes *Cera montana, Cera terrestris, Pissasphaltum nativum*, and *Mumia nativa*. But as often as Mummie is named in this present worke, is not the jewes lime meant, but the Mummie of the Arabians, to wit *Mumia sepulchrorum*, which is found at all Apothecaries under the name of *Mumia*.

The third index is Latin-English and includes diseases and anatomical terms.

At the beginning of volume II of Philemon Holland's translation of Pliny, 1601,[8] there is *A briefe Catalogue of the words of Art, with the explanation thereof*, which, while not as extensive as some of the others, has many terms not found elsewhere.

to *Carminate*, is to make more fine and thin the grosse humors, by such medicins as by their heat are apt to cut and dissolve them; wherupon they likewise be called *Carminative*: a tearme received by Apothecaries, and borrowed from those that card wooll.

Empirickes, were those Physicians, who without any regard either of the cause in a disease, or the constitution and nature of the patient, went to worke with those medicines whereof they had experience in others, fall it out as it would.

Fukes, i. paintings, to beautifie the face in outward appearance. They are called at this day complexions, whereas they bee cleane contrarie: for the complexion is naturall, and these altogether artificiall.

It is evident from these later glossaries that more and more Latin and Greek terms were being used in scientific writing, and that the difficulty of finding English equivalents, as pointed out by Turner, was becoming even more serious. Scientists were aware of this and we find two points of view. In the earlier part of the

century the nationalistic attitude was strong and the tendency was to prefer English words, even if they had to be invented. Christopher Langton in his *An introduction into phisycke* [1550?] expresses this when discussing the cerebellum: " . . . in our tongue we have no propre name for it, which I can do no lesse then count the negligence of our Phisitions to be the cause of: for yf they had wrytten of theyr arte in theyr mother tunge, as they do in other places, why shulde we lacke englysh names, more then we lacke eyther Latyn names or Greke names? and yet to saye the truthe it is better for us English men to have English names, then eyther Latyn or Greke." *

Later it was realized that for the more technical aspects of the sciences Latin or Greek terms were probably preferable. What Thomas Blundeville in *The art of logike*, 1599, said of the terms of logic applied equally to science. He says: " I thinke it no shame nor robberie to borrow termes of the said Art from the Latines, as well as they did from the Greekes: and specially such termes as cannot bee aptly expressed in our native speech: . . . thinking it much better so to doe, then to faine new words unproper for the purpose, as some of late have done."

Thomas Digges has a similar statement in regard to mathematics, and it should be interesting to us to see his emphasis on the historical value of these terms: " . . . let no man muse that writing in the English toung, I have retained the Latin or Greeke names of sundry lines and figures, as cordes Pentagonall, lines Diagonall, Icosaedron, Dodecaedron or such like, for as the Romanes and other Latin writers, notwithstandinge the copiouse and abundant eloquence of their tongue, have not shamed to borrow of the Grecians these and many other termes of arte: so surely do I thinke it no reproche, either to the English tongue, or any English writer, where fit words faile to borowe of them both, but rather should we seeme thereby to do them great injurie, these beeing in deede certaine testimonies and memorials where such sciences first tooke their originall, and in what languages and countries they chiefllie florished, which names or wordes how straunge soever they seeme at the firste acquaintaunce, by use wyll growe as familiar as these, a Triangle, a circle,

* D₂.

or such like, which by custome and continuance seeme meere English. . . . "[18]

This trend is particularly marked in John Dee's list of sciences. He evidently invented many of the terms, from Greek and Latin roots. In many instances his name for a science appears to be the first use of the word in English, and in some cases apparently the only one. This statement is based, of course, on the occurrence of such words in the *New English Dictionary*. Quite a few of the definitions from these glossaries are given as examples in the *N. E. D.*, and of the terms there seem to be very few omitted. Of the various works studied it would seem that all but Wirsung and Norton were consulted in the compilation of the Dictionary. Generally, though, the quotations in the *N. E. D.* are short, and hence many of the most important definitions do not appear. This is true, for instance, of those in Halle's *Table*.

As has been said, sometimes a term is defined in only one glossary, but in general there are definitions for the same word in a number of the glossaries. This frequently gives an interesting comparison of the changes in meaning during the period.

Taken together all these various glossaries and other works with definitions are the most complete sources available for a knowledge of the scientific language of this age. There were no scientific dictionaries as such until the middle of the next century. But since the glossaries are scattered in books that are not easily accessible, it might be advisable to bring them all together in one volume. They would then constitute an important collection for the study of the history of science and of the language.

A Chronological List of Works Containing Glossaries

1. The grete herball. fol. Southwarke, P. Treveris, 1526; 1529; newly corrected. fol. London, in ed. T. Gybson, 1539; fol. London, J. Kynge, 1561.

   The definitions are from the *exposicyon* of the 1539 and 1561 editions. The *exposicyon* occurs in all editions.

2. Vigo, Joannes de. The most excellent workes of chirurgerye made by M. J. Vigon. Translated B. Traheron. 4°. London, E. Whytchurch, 1543; fol. 1550; fol. London, T. East and H. Middleton, 1571; 4°. London, T. East, 1586.

   The Interpretation of straunge wordes is the same in all editions.

3. Bullein, William. Bulleins bulwarke of defẽce againste all sicknes, sornes, and woundes. fol. London, J. Kyngston, 1562; fol. London, T. Marshe, 1579.

   The short glossary appears in both editions.

4. Lanfranc. A most excellent and learned woorke of chirurgerie called Chirurgia parua Lanfranci, published by J. Halle. 4°. London, T. Marshe, 1565.

   The quotation from the Proheme, M_2r.

5. Dee, John. Mathematicall Preface, in Henry Billingsley's translation of Euclid, The elements of geometrie. fol. London, J. Daye, 1570.

   The large folding table, inserted between A_4 and B_1, may be considered a glossary in that it brings together most of the definitions in the text.

6. Bartholomaeus, *Anglicus*. Batman vppon Bartholome his booke De proprietatibus rerum, enlarged and amended. fol. London, T. East, 1582.

7. Wirsung, Christoph. Praxis medicinae vniuersalis, or a generall practise of physicke. Translated by Jacob Mosan. fol. London, E. Bollifant, 1598; fol. London, G. Bishop, 1605; fol. London, [J. Legat] for T. Adams, 1617; London, for F. L. H. Hood, A. Roper, & R. Tomlins, 1654.

   The indexes appear in all editions.

8. Plinius Secundus, Caius. The historie of the world. Translated by Philemon Holland. fol. London, A. Islip, 1601; 1634; 1635.

9. Norton, Robert. A mathematicall appendix for mariners at sea. 8°. London, R. B[lower] for R. Jackson, 1604.

Some Works with Definitions in the Text

10. Recorde, Robert. The grounde of artes, teachyng the worke and practise of arithmetike. 8°. London, R. Wolf, 1542.

    For the many later editions see *Short-Title Catalogue*.

    ——— The pathway to knowledg, containing the first principles of geometrie. 4°. London, R. Wolfe, 1551; London, J. Harrison, 1574; 1602.

    ——— The castle of knowledge. fol. London, R. Wolfe, 1556; 4°. London, V. Sims, 1596.

    Definitions of Cosmography.

    ——— The whetstone of witte, which is the seconde parte of arithmetike. 4°. London, J. Kyngston, 1557.

11. Borde, Andrew. The breuiary of healthe. 4°. London, W. Middleton, 1547; London, W. Powell, 1552; 1557; London, T. East, 1575; 1587; 1598.

12. Cuningham, William. The cosmographical glasse. fol. London, J. Day, 1559.

13. Digges, Thomas. Edited and added to the works of his father Leonard Digges.

A geometrical practise, named Pantometria. 4°. London, H. Bynneman, 1571; fol. London, A. Jeffes, 1591.

The quotation from Thomas Digges is from the preface to his own lengthy treatise, *A Mathematicall Discourse of the 5 Platonicall Regular Solides*, which he appended to the 1591 edition, pages 97-98, Sig. O_1.

——— An arithmeticall militare treatise, named Stratioticos. 4°. London, H. Bynneman, 1579; London, R. Field, 1590.

14. Blundeville, Thomas. A briefe description of vniuersall mappes and cardes. 4°. London, R. Ward for T. Cadman, 1589.

"Tearmes of Cosmographie."

15. Lucar, Cyprian. A treatise named Lucar—solace. 4°. London, R. Field for J. Harrison, 1590.

Mathematical definitions.

THE HISTORY OF HEART-BLOCK

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The widespread and extensive use of the most recent addition to the study of clinical cardiology, the electrocardiograph, has made a very fascinating study of the minutiae of the electrical alterations of the heart as betrayed by its conducting system. In many of the reports in the literature on the various phases and types of heart-block since William Einthoven introduced his string galvanometer in 1902, such exacting details are given of the block itself and its treatment that too often the patient with his symptoms have been completely overlooked. Although much has been added to the subject by the experimental and clinical studies on the variations of heart-block in man, the clinical infrequency and yet often diagnosed types of block based on electrocardiographic similarities to experimental studies certainly suggests that the solid groundwork for the basis of heart-block has not pervaded the domains of clinical cardiology where the electrocardiograph reigns supreme instead of being a good disciple as its originator intended it should remain.

It all began in 300 B. C. when Herophilus, whose teacher Praxagoras was the first to use the pulse as an aid to diagnosis, described, timed, and compared the variations of the pulse to musical rhythms. He used a clepsydra, or water-clock, for timing the pulse and apparently recognized the significance of the variations of the pulse as a guide to the general condition of the body. A name which he used to describe one type of pulse is still in use today; the goat-like or bounding pulse, the "pulsus capricans or dicrotus." Herophilus originated the complex pulse-lore on which Galen later wrote sixteen essays, and the essence of which were current up to the Napoleonic period.

Centuries later Aegidius Corboliensis of the Salernitan School, whose writings were in metrical form, described no less than fifteen varieties in a table included in his tract "De Pulsibus." Flint translated the headings under which Aegidius wrote his short pithy verses as follows:

Concerning The Pulse And Its Signs.

On A Large Pulse.
In What Does A Large Pulse Consist?
Definition of a Small Pulse.
Strong or Weak Pulse.
Slow or Fast Pulse.
Hard or Soft Pulse.
Empty or Full Pulse.
Hot or Cold Pulse.
Frequent or Rare Pulse.
Pulsus Decidens.
Equal Pulse.
Unequal Pulse.
Irregular Pulse.

In the Middle Ages a few suggestions appeared as to the timing of the pulse but these original efforts remained unnoticed. Cardinal Nicolaus Cusanus, originally Nikolaus Krebs, of Cues, a good mathematician, made some suggestions in his " Dialogue On Statics " (1450). He advised comparing the frequency of the pulse and the respiration in disease with that in normal controls as estimated by the water-clock, but this advice was not carried into practice.

The celebrated Paduan professor, Sanctorius or Santorio Santorio, in his commentary on the first book of the Canon of Avicenna (Venice, 1625) described his invention, the pulsilogium (pulsilogram) or pulse-clock. Sanctorius obtained his ideas from Galileo who originally conceived the principle of using his own pulse to test the synchronous character of a pendulum's vibrations; this led Galileo to the converse proposition of measuring the rate and variation of the pulse by the pendulum, much as a metronome is used to check the tempo of music. The pulse-clock of Sanctorius soon passed into the limbo of forgotten things for the next century.

The first physician to make regular observations on the rate of the pulse was Sir John Floyer, who, in 1707, published his " Physician's Pulse Watch." This effort revived the forgotten work of Galileo and Sanctorius. The ordinary watch used in Floyer's time had a single hand only and recorded the hours, not the minutes or

the seconds. Floyer's pulse watch ran exactly one minute and for the first time the rate of the heart was determined fairly accurately by counting the number of beats in a minute by his watch. He described the pulse of age and youth, pregnancy, exercise and sleep, and noted how the diet, blisters, and weather affected the pulse. His work was neglected because of a revival of the old Galenic doctrine of specific pulses.

The first physician to note and record the slow pulse associated with fainting fits was Marcus Gerbezius, or Verbez, of Laibach, who was also the author of a work in which he stressed the importance of weather and climate upon the origin and development of disease. Verbez published a large number of observations in the transactions of the Leopold Academy of Natural Sciences. His account of what appears to be the first mention of this syndrome was taken from the "Appendix ad Ephemeridem Academiae Caesaro-Leopoldino-Carolinae Naturae Curiosorum in Germania," 1719, Centuriae VII et VIII, p. 23:

> "... More unusual moreover I observed this in two patients about the pulse: truly that one of them a melancholy hypochondriac indeed had commonly when well a pulse so slow, that before a subsequent pulse followed the preceding one, three pulsations would have certainly passed in another healthy person; who moreover after the passing of August fell into a malignant fever, had on the contrary a frequent pulse, and through all the different ills of varying kinds, such as I had never observed. Therefore afterwards as the commencement of the disease and until now I had predicted a bad termination of the illness. Such remarkable departure from nature, from the healthy state did not seem possible and only the worse fate was predicted. The man at other times was robust, exact in his movements, but is now slow, often seized with dizziness, and from time to time subject to slight epileptic attacks."

The second apparent case of this syndrome, previously completely overlooked except for a brief notation by Garrison, was described by George Cheyne in his book on the "English Malady" in 1733. This was the case of the Honorable Colonel Townshend who, in

addition to a kidney complaint, explained that he could " die or expire when he pleased " and "yet by effort come to life again." The Colonel described the sensations coming on and then lapsed into unconsciousness. Dr. Cheyne noted the slowing and disappearance of the pulse, and his colleague, Dr. Baynard, could not feel the least motion in the heart. Both physicians considered the Colonel dead and were leaving when he came to life, pulse and motion of the heart gradually returning. Cheyne was very puzzled about this. In another attack on the same day the Colonel died, and at an autopsy Cheyne recorded that the " heart big and strong."

The Galenic influence was still strong as noted from the writings of Theophile de Bordeu, the founder of the vitalistic school at Montpellier. He developed a very complete and complex classification of the pulse as critical, non-critical, simple critical, compound critical, nasal, tracheal, gastric, renal, uterine, seminal, etc., etc.

It has been frequently stated that the first description of the syndrome of fainting associated with slow pulse was by Morgagni in 1761. Burnett was the first to call attention to this in his later report on the syndrome. Morgagni reported the case of his fellow citizen under " Letter The Ninth Which Treats of Epilepsy," but he did not suggest that the cause was cardiac, the ventricles and auricles contracting independently of one another. The report that went unrecognized for the next 63 years was the case of Anastasio Poggi, priest, aged 68 years, moderately fat, florid complexion, who was first seized with epilepsy at this advanced age, " which left behind it the greatest slowness of the pulse," which remained. Morgagni gave the various known causes of epilepsy of that period, and the treatment used, but with no results in this patient. He described the seizures fully as regards what increased and decreased their frequency as well as the severity of the convulsions. The onset of dyspnea led to the suspicion of dropsy of the thorax and Morgagni confirmed this when he noted edema of the right leg. One-half grain doses of powdered opium at bedtime gave the patient a fairly good night's rest and relieved him of his severe symptoms. The observations of Gerbezius were mentioned in this report by Morgagni, who concluded the case history of his fellow citizen by stating that the patient had no attacks for 13 days while on powdered opium

and this medication reduced the attacks from one per day to two attacks in five months.

Thirty-two years elapsed before another case of this syndrome was described, this time by an outstanding but frequently unmentioned and overlooked Scottish physician, Thomas Spens of Edinburgh. Young Spens was 24 years old when he reported this case. Its publication led to his election as a Fellow of the Royal College of Physicians one year later at the early age of 25. Spens was successively Librarian, President, and, for the last 33 years of his life, Treasurer of the College. This first account of the syndrome by a British physician preceded that of Adams by 35 years and Stokes by 53 years. The case report appeared in a book of 592 pages, entitled, " Medical Commentaries For The year 1792, Exhibiting a Concise View of the Latest and Most Important Discoveries In Medicine and Medical Philosophy," collected and published by Dr. Andrew Duncan of Edinburgh.

Spens saw a 54 year old male mechanic on May 16, 1792, and noted that the pulse of this man was 24 beats per minute. From the history, the patient had the first attack of unconsciousness at 3 p. m. on that day and he had three similar attacks by 9 p. m., when Spens saw him. The patient attributed the attacks to intoxication. He had several attacks during the night and the next morning Spens found the pulse rate the same. The use of vinegar, aromatic spirits of ammonia, and wine prevented the onset of the attacks. On the 19th, three days after the onset, Spens noted that at the beginning of one attack the pulse dropped to ten beats per minute. The patient continued downhill with loss of speech, but had no further convulsions. He lost the movement of the right hand and leg and expired on the morning of the 20th, four days after the onset of the first seizure. At autopsy no cause could be found in the thorax or in the head as the influencing factor in the convulsions. Spens later learned that the patient had a fever two years previous to this fatal illness, and the surgeon who attended him noted a pulse of 120 which returned to 60-70 when the fever subsided. The question of hydrocephalus as the cause of the slow pulse was considered to be discredited by Spens. This was a very excellent case report but missed the main point, the relation of the slow pulse to the action of the

heart. Spens, however, was the first physician to really question the syndrome, with its fits and slow pulse which had been considered a primary nervous affection, as being of that origin.

The fifth report on this syndrome, and the first to definitely place it in the realm of cardiology, appeared in 1827, from the pen of one of the earliest outstanding Dublin physicians, Robert Adams. He described his case partly as follows:

> "An officer in the revenue, aged 68 years, of a full habit of body, had for a long time been incapable of any exertion, as he was subject to oppression of his breathing and continued cough. In May, 1819, in conjunction with his ordinary medical attendent, Mr. Duggan, I saw this gentleman: he was just recovering from the effects of an apoplectic attack, which had suddenly seized him three days before. He was well enough to be about his house, and even to go out. But he was oppressed by stupor, having a constant disposition to sleep, and still a very troublesome cough. What most attracted my attention was, the irregularity of his breathing, and remarkable slowness of his pulse, which generally ranged at the rate of 30 in a minute. Mr. Duggan informed me that he had been in almost continual attendance on this gentleman for the last seven years; and that during this period he had seen him, he is quite certain, in not less than twenty apoplectic attacks. Before each of them he was observed, for a day or two, heavy and lethargic, with loss of memory. He would then fall down in a state of complete insensibility and was on several occasions hurt by the fall. When they attacked him, his pulse would become even slower than usual; his breathing loudly stertorous. He was bled without loss of time and the most active purgative medicines were exhibited. . . . He recovered from these attacks without any paralysis. Oedema of the feet and ankles came on early in December; his cough became more urgent, and his breathing more oppressed; his faculties too became weaker."

In the same month this man was suddenly seized with an apoplectic attack and died in two hours, before the arrival of his regular medical attendant. At autopsy the extreme degree of fatty degeneration

of the heart muscle led Adams to consider this as the cause of the condition.

At the same time that Adams reported this case of the revenue officer, an exactly similar case was reported in greater detail by William Burnett of London. Hirschfelder stated that Burnett's observations were reported even more carefully and in greater detail than those of Adams and ill deserve to have fallen into oblivion. Whereas, Burnett described his as a case of epilepsy as Morgagni had done, Adams attributed his case to a disease of the heart. Burnett served as a navy surgeon for many years and eventually he became physician-general of the navy, in which capacity he introduced many most valuable reforms.

In his report Burnett quoted the work of Morgagni fully and well. It was read on April 12, 1824 and communicated by Dr. James Johnson to the Medical and Chirulogical Transactions of London; it appeared in publication after a lapse of several years, in 1827. Burnett described the case of a naval officer, aged 46 years, who had a single attack of epilepsy at the age of 30 years. In 1820, while he was in bed, he had the next attack at the age of 42 years. Burnett saw him in August, 1820 and concluded that the man had epilepsy. The officer remained well until January 27, 1821 when he had many attacks. Burnett continued:

> "About the latter end of April or the beginning of May, I was again called upon to visit him, and found the paroxysms had been slighter, and not so frequent, but he complained of great uneasiness and sistention about the epigastrium, which some purgative he had previously taken had failed to remove. He also complained of dyspnea, which frequently made it necessary for him to sit up in bed; and on examining his pulse, I found it to beat 36 to the minute, but it was regular and small. On the following morning the pulse was only beating twenty in the minute, but in the evening it got up to 32, and from this time till the 6th of May, it varied from 28 to 56, but was generally under the latter number, though without any return of the paroxysms."

The seventh case was reported in 1841 by Holberton, whose

description was similar to Burnett's, termed simply "A Case of Slow Pulse With Fainting Fits," but not as adequately described as the latter's case report.

In the next year the text of James Hope of London appeared, but there is no evidence in this book that Hope was aware of such a condition characterized by the slowness of the pulse; or perhaps he omitted it because he felt that the condition belonged in the realm of neurology. Balfour, in his book on heart disease, stated that it is long since Hope pointed out that though cardiac action was really slow, yet the bulk of these cases in which the pulse was said to range from 20 to 30 per minute, were really cases in which one or two of the ventricular beats were regularly and permanently imperceptible in the pulse, every second or third pulsation only reaching the periphery. This statement was found only in the 1839 edition of Hope's book and was omitted from later issues.

Adams first attributed the syndrome to disease of the heart; then William Stokes very clearly and accurately, for the first time described all the cardiac findings that have become so definitely linked with their combined names. Stokes was the one, who, while still a medical student, published in 1825, a small "Treatise On The Use Of The Stethoscope," the earliest systematic work on the subject in the English language. He reported his cases of this syndrome in 1846, and first indicated that although this combination of symptoms is very curious, it is a special group of symptoms. The patient was Edmund Butler, aged 68 years, whom Stokes saw in the Meath Hospital on February 9, 1846. Mr. Butler had fainting spells for three years, totaling about fifty seizures, and found spirits the best to relieve his attacks. Stokes describes the heart findings as follows:

> "The impulse of the heart is extremely slow, and of a dull prolonged, heaving character, giving the idea of feeble as well as of slow action. The first sound is accompanied by a soft *bruit de soufflet*, which is prolonged until the commencement of the second sound, and is heard very distinctly up along the sternum and even into the carotid arteries. The second sound is also imperfect, though very slightly so; the imperfection being much more evident after some beats than after others. Pulse 28 in the minute, of a prolonged sluggish character; the

arteries pulsate vividly all over the body, but no *bruit* is audible in them."

Mr. Butler continued to improve and soon learned to ward off the attacks by a peculiar manoeuvre. Stokes said:

> "As soon as he perceives symptoms of the approaching, attack, he directly turns on his hands and knees, keeping his head low, and by this means, he says, he often averts what otherwise would end in an attack."

The patient left the hospital in March, much improved and free of attacks. In June he was re-admitted to the hospital, and Stokes added:

> "The cardiac phenomena remain as before, but a new symptom has appeared, namely, a very remarkable pulsation in the right jugular vein. This is most evident when the patient is lying down. The number of reflex pulsations is difficult to be established, but they are more than double the number of the manifest ventricular contractions. About every third pulsation is very strong and sudden, and may be seen at a distance; the remaining waves are much less distinct, and some very minor ones can be also perceived. These may possibly correspond with those imperfect contractions which have already been noticed in the heart. The appearance of this patients' neck is very singular, and the pulsation of the veins is of a kind which we have never before witnessed."

Stokes may not have had any understanding of the nature of these "semi-beats" nor of the functional disturbance associated with them. Yet, from his lucid description, one cannot help but marvel at the ability of this keen observer to note all the detailed cardiac findings of this peculiar syndrome; one ceases to question why his name is indelibly associated with it.

A few years later Stokes found it necessary to defend his views on the subject, and this he did in 1854 when his book on heart disease was published. Misinterpretation and lack of understanding of his original article led him to say:

> "It is hardly necessary for me to observe, that I never thought of attributing slowness of the pulse to disease of the aorta or its valves. The object of my paper was to show that the frequent combination of disease of the aortic orifice with fatty degeneration of the heart might be made to assist in the diagnosis of the latter affection, inasmuch as under these circumstances there was produced a group of symptoms and signs having a special character, namely, the combination of a slow pulse, pseudo-apoplectic attacks, and a murmur propagated into the aorta while the second sound remained clear. In fact, my observations were based upon, and intended to illustrate, the views of Dr. Adams on fatty degeneration of the heart."

Perhaps the re-introduction of the use of the watch to time the pulse by the first physician after Floyer, Pierre-Charles-Alexandre-Louis of Paris, in which he was followed by the clinicians of the Dublin and London schools, led to a better understanding of the slow pulse associated with the fainting fits; perhaps this did not; the book on heart disease by Peter Mere Latham, which appeared in 1847, contained nothing at all on the pulse.

While Stokes was elaborating and defending his views on the subject, an experimental genius made an independent attempt to discover the nature of the heart-beat in the frog. Hermann Stannius of Hamburg placed a ligature at the junction of the auricle and the sinus venosus and brought the heart to a standstill. He placed a second ligature between the auricle and the ventricle and the ventricle began to beat again. The work of Stannius gathered much dust in the next 25 years.

Some of the clinical views expounded on the subject during the following years were more unique than interesting. When Austin Flint published his book in 1859 he considered the subject under the title, "Fatty Growth and Degeneration," but referred to the work of the Irish clinicians under seizures resembling apoplexy. Walter Hayle Walshe, under the chapter in his book entitled, "Fatty Metamorphosis of the Heart," where he described the type of pulse noted in this condition, stated:

> "A third, and more noteworthy and special condition of the pulse is infrequency—sometimes carried to a very remarkable

extreme, the beat falling, for instance, to 26 in the minute (J. B., private case, May, 1854). Such infrequency is in some cases referable to extra-weakness of the occasional systoles; but, as originally noted by Dr. Adams, the ventricular systoles themselves are occasionally much less frequent than natural; and, in point of fact, defect in the cardiac action itself is the really important condition."

In 1872 John Milner Fothergill published his book on heart disease but mentioned nothing concerning the pulse. Four years later George William Balfour gave the syndrome thorough consideration under the chapter of the book entitled, "On Intermittancy and Irregularity of the Pulse, and On Palpitation, Cardiac and Aortic." He stated:

"There is one form of abnormality, however, in a gouty heart which I do not hold to be so susceptible of a favourable prognosis. I refer to that to which attention is ordinarily first directed by the occurrence of symptoms referable to cerebral anemia, in which the abnormal slowness of the pulse is the most remarkable symptom—a slowness of the pulse not because the cardiac action is slow, but because many of the pulsations fail to reach the periphery."

Balfour mentioned the work of Stokes and the remarks of Hope on the subject, then continued on to describe a case of his own:

"In one very instructive case which I saw some years ago, an old lady, long gouty, though without regular attacks, and with a dilated feeble heart, had been suddenly seized while shopping with what seemed to be an epileptic attack. These attacks continued to recur when she made the slighest exertion, and at the time I saw her she was unable to rise from a recumbent position without bringing on one. They were associated with flatulent dyspepsia and an extremely slow pulse, averaging about 20 in the minute. On careful examination I found that her heart acted with perfect regularity, but with unequal force, so that the apparently abnormal slowness of the pulse was simply due to the fact that only about every third beat reached the periphery. It was not difficult to connect this defective

> cardiac action with diminished arterial pressure, generally sufficient to produce all the phenomena of cerebral anemia on the one hand, and among these epileptic seizures, and also defective secretion generally, and as one of the results of the flatulent dyspepsia. There is but one remedy that I know capable of remedying this state of matters, if indeed the muscular fibre be still perfect enough in structure to permit its being remedied, and that is digitalis; full doses of that were prescribed, and with nutritious diet and fair allowance of stimulants, it succeeded so well in her case that within a week she was going about as usual, was so well, indeed, as to give a dinner party, and she died gradually from asthenia some years subsequently without any return of these serious symptoms. Such cases are, however, always more serious than those of simple irregularity of the cardiac action, and are not always so simply to be remedied, considerable degeneration of the cardiac muscle being only too frequently concomitant."

Numerous investigations carried on by many independent workers on the conduction of the heart in lower animals aroused new interest in the clinical syndrome under consideration. Walter Holbrook Gaskell, perhaps Foster's greatest pupil, presented a physiologic demonstration of the muscular continuity between the auricle and ventricle in reptiles. While Gaskell was carrying on this work on the myogenic conduction of the heart, Chauveau published his observations of a case in which he gave venous tracings to prove that the auricle and the ventricle contracted at different rates and entirely independent of one another. His patient had a pulse rate of 24 beats per minute and suffered from occasional attacks of vertigo and loss of consciousness. Tracings made by Chauveau from the apex showed a series of large beats at regular intervals corresponding to the loud heart sounds and to the radial pulse, and also a second series of very small notches occurring at very regular intervals but bearing no relation whatever to the beats of the ventricle. As in the cases of Stokes, these small pulsations were accompanied by " small sounds which gave the illusion of reduplication of either heart sound." The usual presystolic notch due to the auricular beat was absent, and Chauveau concluded that the small notches were

due to the contractions of the auricles which were beating at a rate of 66 per minute, while the rate of the ventricles was 24 per minute. He also investigated the matter experimentally, and was able to demonstrate in horses that upon stimulation of the vagus the auricles could be observed to beat more frequently than the ventricles. This led him to the conclusion that the dissociation of auricular and ventricular rhythm was due to over-stimulation of the vagus.

Wooldridge, under Ludwig's direction, investigated the course of the nerves in the cardiac septum, and his results, although disregarding the muscular connections between the auricle and the ventricle, were confirmed by Tigerstedt in 1884. Finally in 1893 Wilhelm His, Jr. and Stanley Kent fully described the auriculo-ventricular bundle in mamals. Two years later His produced heart-block experimentally and was the first to suggest that the independent auricular and ventricular rhythm was caused by a lesion of the auriculo-ventricular bundle which blocked the stimulus in its passage from auricle to ventricle.

These anatomical findings and experiments of Kent and His, and the work of their predecessors, were confirmed by Braenuning, Humblet, Retzer, Hering, and Tawara. At the close of the nineteenth century, Huchard, who in 1890 was the first to call the condition "Adams-Stokes Disease," still was of the opinion that the syndrome was due to spinal cord changes.

George Alexander Gibson, a pupil of Balfour's, expressed an entirely different viewpoint in his book which appeared in 1898. Under the heading of "Recurrent Bradycardia," Gibson termed the condition "Stokes-Adams Disease," according to Huchard. Gibson's views were clear and explicit on the subject, as can be noted from the following quotation:

> "It is rather difficult, on account of the comparative rarity of the affection, to have any statistics of value as to the relative frequency of different lesions, but it seems probable that fibroid changes are rather more frequent than alterations of a fatty character."

Gibson stated that he had no success with digitalis in this condition, such as his teacher had reported, but continued:

> "The starting point of the complex of symptoms is to my mind clearly the heart. When the sclerosis of the arteries of the brain diminishes its blood supply, and when the heart lessens its activity, the quantity reaching the brain is too small to sustain cerebral functions, hence the faintness, giddiness, unconsciousness, and convulsions."

Previous to the introduction of the electrocardiograph the two important concepts regarding the syndrome had been definitely established, although far from being generally accepted. These, as Hirschfelder pointed out, were:

1. That the slow pulse of Adams-Stokes disease was due to dissociation between the auricles and the ventricles (heart-block), and to the slow independent rhythm of the ventricles;

2. That the syncopal attacks (Adams-Stokes Syndrome) were due to cessation of the ventricular beat but not of the auricular beat.

The introduction of the electrocardiograph enabled clinicians to learn much about the details of the action of the conduction system in the heart, especially in regard to the types of heart-block which cannot be detected or studied without this means, the sino-auricular, partial and bundle-branch blocks. The graphic illustration and illumination of all these conduction defects by means of this machine brings one to admire all the more the astuteness of the great nineteenth century clinicians, especially the keen observers of the Irish school, Adams and Stokes. In conclusion, however, it cannot be too strongly emphasized that complete heart-block and Adams-Stokes syndrome are by no means synonymous, and that heart-block may persist for months or years without the occurrence of the syndrome. These later opinions regarding the prognosis and relation of heart-block are the contributions of modern clinicians in whose experienced hands the electrocardiograph has been and is a highly respected disciple.

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JOHN HOWARD ON COMMUNICABLE DISEASES

JOHN E. RANSOM

Appointed High Sheriff of his home County of Bedfordshire in 1773, John Howard at the age of forty-seven entered on a period of prodigious activity and great accomplishment. Disturbed by certain abuses in the management of the jails in his jurisdiction and hoping to find a corrective therefor, he set out to learn something of jail management in some of the neighboring counties. This brief tour of inspection marked the beginning of seventeen years of untiring, persistent travel to every corner of the British Isles, to practically every country of Continental Europe and to some of the coastal cities of Asia Minor.

Up to 1773 he had lived the life of a kindhearted Christian gentleman of wealth and leisure. During his remaining years, he worked incessantly, suffered hardships and every inconvenience, driven as it were by a consuming zeal to learn all he could of the conditions of prisons throughout the civilized world and as well of hospitals and institutions of every sort and to do what he could to make the lives of those who lived in them more comfortable and more salutary.

In addition to many journeys in his own country he made in all seven tours of institutional inspection in Continental Europe, successfully lobbied for reform legislation, worked in and for the church of his choosing, wrote several books, and with it all, did not neglect his responsibilities to his tenants or to his mentally-ill son. Not only did he make himself the universally recognized pioneer of prison reform, but demonstrated that life may begin at even a later age than forty. Cecil Rhodes' regretful maxim " So much to do, so little time to do it," may well have been inspired by the fervid, fruitful life of his fellow countryman, John Howard.

Quite naturally in the prisons, hospitals, lazarettos and like institutions Howard visited, he frequently came in contact with sickness and the means and methods employed to combat it. Being of an inquiring mind and seemingly interested in every problem of human

welfare, he records in his books many interesting observations on the state of medical knowledge in his day.

In the jails and prisons of England he learned of many outbreaks of jail fever. In the introductory chapter of his first book "The State of the Prisons in England and Wales" published in 1784, he says "From my own observations in 1773, 1774 and 1775, I was fully convinced that many more persons were destroyed by gaol fever, than were put to death by all the public executions in the whole Kingdom. This frequent effect of confinement in prison seems generally understood, and shows how full of emphatical meaning is the curse of a severe creditor, who pronounces his debtor's doom to *rot in gaol*. I believe I have learned the full import of this sentence, from the vast numbers who, to my certain knowledge, and some of them before my eyes, have perished by the gaol fever.

"But the mischief is not confined to prisons. Not to mention now the number of *sailors*, and *families* in America, that have been infected by transports. Multitudes caught the distemper by going to their relatives and acquaintances in the gaols; many others from prisoners discharged; and not a few in the courts of judicature."

This reference to transports is of interest because of the fact that the American Revolution had not as yet upset England's system of transportation of criminals, leading as it did to the substitution of Australia for his Majesty's Colonies in North America as the place to which she might ship her seemingly most undesirable citizens.

He goes on to bolster his argument by quoting Lord Bacon on the famous Black Assize held in Oxford Castle in 1577. It had been reported that all persons who had been present at a certain court session held there died within forty hours—"The lord chief baron, the sheriff and about three hundred more." The Lord Chancellor Bacon attributed this to a disease brought into the court by the prisoners, and goes on to say,—"The most pernicious infection next the plague, is the smell of a jail; when the prisoners have been long and close and nastily kept: whereof *we have had, in our time, experience twice or thrice*; when both the judges that sat upon the jail, the numbers of those who attended the business, or were present, sickened and died."

Among other instances of jails being a fertile source of this in-

fection, Howard says—" Dr. Lind, physician to the Royal Hospital at Haslar, near Portsmouth, showed me in one of the wards a number of sailors with the gaol-fever, brought on board their ship by a man who had been discharged from a prison in London. The ship was laid up on the occasion. That gentlemen in his Essay on the Health of Seamen, asserts, that, " The source of infection to our armies and fleets are undoubtedly the jails; we can often trace the importers of it directly from them.—It often proves fatal in impressing men on the hasty equipment of a fleet.—The first English fleet sent to America in the last war, lost by it about two thousand men." In another place he assures us, that " the seeds of infection were carried from the guardships into our squadrons—and the mortality, thence occasioned, was greater than by all other diseases or means of death put together."

At the end of his book on The State of Prisons in England and Wales, Howard adds a chapter which he entitles " Remarks on the Gaol Fever." He says in part, " I shall take the liberty here to subjoin a few additional remarks on the gaol fever; in which, if I shall appear to have invaded the province of the gentlemen of the faculty, I hope to be pardoned, from the consideration that my experience in this matter, may in some respect supply my want of other means of knowledge.

" If it were asked, what is the cause of the gaol fever? it would in general be readily replied, ' the want of fresh air and cleanliness.' But as I have found in some prisons abroad, cells and dungeons as offensive and dirty as any I have observed in this country, where, however, this distemper was unknown, I am obliged to look out for some additional cause for its production. I am of the opinion, that the sudden change of diet and lodging so affects the spirits of new convicts, that the general causes of putrid fevers exert an immediate effect upon them. Hence it is common to see them sicken and die in a short time, with very little apparent illness. Convicts are generally stout robust young men, who have been accustomed to free diet, tolerable lodgings, and vigorous exercise. These are ironed, and thrust into close offensive dungeons, and there chained down, some of them, without straw or other bedding; in which they continue, in winter, sixteen or seventeen hours out of twenty-four, in

utter inactivity, and immersed in the noxious effluvia of their own bodies. On this account, the gaol-distemper is always observed to reign more in our prisons during winter than summer; contrary, I presume, to the nature of other putrid diseases. Their diet is at the same time low and scanty; they are generally without firing; and the powers of life soon become incapable of resisting so many causes of sickness and dispair.

"On my visit in 1779, I found only one person ill of the gaol-fever; he was in Newgate, under sentence of death. In 1782, I did not find a single person labouring under the disorder throughout the whole kingdom. But in 1783, when the prisons became crowded from the peace, I was sorry to observe, that through the original faulty construction of many of them and the want of attention in magistrates properly to inspect them, and enforce the orders of the act for preserving the health of prisoners, they were beginning to return to their former wretched state."

This was not the first instance in which Howard reminded his readers that crime was more rife and prison population greater in times of peace than in times of war. During the latter the more disorderly elements in the population were in the Army or the Navy.

"Several instances of alarming and fatal sickness in gaols have since been communicated to me, some of which I have noted in their proper places. I have to remark, however, that it appears doubtful to me, whether, in some of these, the disorder was the proper gaol-fever, produced in and peculiar to such situations; or an epidemic disease, which attacked prisoners only in common with other inhabitants of the same town. It cannot be expected that gaols should be preserved free from such visitations as these; it is only to be hoped, that care and attention will be used, to prevent the disease from becoming more malignant and fatal in these, than in other places.

"It may not be improper here to put persons on their guard against an artifice not unfrequently practiced by gaolers, in order to prevent a proper examination of their prisons. When a gentleman, particularly a magistrate, has come with an intention to visit the gaol, the keeper has pretended the utmost willingness to accompany him, but at the same time has artfully dropt a hint that he

fears there may be some danger in it, as he is apprehensive that the fever has made its appearance among them. The visitor, alarmed, returns thanks for the kind caution, and instantly leaves the house.—On such occasions I have always the more insisted on the necessity of a close inspection; and have generally found the prison very dirty, indeed, and out of order, but no fever."

In another connection, he says: "I sat an afternoon with Dr. Duntze of Bremen, who told me he was in London in 1753 and 54, with an inquisitive friend, a German. They went into Newgate to observe the effects of the ventilator; and were struck with an offensive smell in one of the rooms. Next day they were both indisposed. The Doctor's complaint turned out a kind of jaundice. After a few days confinement he visited his friend, and found him excessively low; and in a short time he died with every symptom of the gaol fever."

Again he remarks: "In visiting the prisons of Italy, I observed, that in general great attention was paid to the sick; but I could not avoid remarking, that too little care was taken to prevent sickness. From the heat of the climate, one might imagine the gaol-fever would be very likely to prevail; but, I did not find it in any of the prisons.

"On conversing with a physician, concerning the treatment of the sick when the plague was at Moscow in 1772, he said, 'it was nearly the same with ours in the gaol-fever, viz. bark and good broths, with as much air as possible.' The late Sir John Pringle, President of the Royal Society, in his discourse at the Anniversary meeting, 30th November 1776, informs us that 'the late Dr. Mounsey, F. R. S., who had lived long in Russia, and had been Archiater under two successive sovereigns—happening to be at Moscow when he persued the Observations on the Jail-fever—was induced to compare what he read in that treatise with what he should see in the several prisons of that large city; but to his surprise after visiting them all, and finding them full of malefactors (for the late empress then suffered none—to be put to death) he could discover no fever among them, nor learn that any acute distemper peculiar to jails had ever been known there.—Upon his return to St. Petersburg, he made the same inquiry there, and with the same result.

" ' In this ancient capital of Russia, I found no traces of any such prisons or dungeons as were common formerly in the castles of England, and in several foreign countries. That cruel mode of confinement in many of our prisons has been, and still is a principal cause of the gaol-fever: no symptoms of which fever did I see in Moscow, of in any part of Russia.' "

On the report of one of his visits to the prisons in Switzerland he records: " At Lausanne I visited the prison, in which there were at that time no prisoners. There were dungeons; but on entering each of them, the keeper observed, that we were not yet upon the ground, but there were cellars underneath. On conversing with Dr. Tissot, he expressed his surprise at our gaol-distemper; said, ' I should not find it in Switzerland ': and added, that ' he had not heard of its being anywhere but in England.' When I mentioned the late act of parliament for preserving the health of our prisoners, he approved of it highly, especially the clause which required *white-washing the rooms, and keeping them clean.*—I did not (as the doctor said) find the gaol-fever in Switzerland.

" I have been frequently asked what precautions I use, to preserve myself from infection in the prisons and hospitals which I visit. I here answer, next to the free goodness and mercy of the Author of my being, temperance and cleanliness are my preservatives. Trusting in Divine Providence, and believing myself in the way of my duty, I visit the most noxious cells; and while thus employed, ' I fear no evil.' I never enter an hospital or prison before breakfast, and in an offensive room I seldom draw my breath deeply."

In his Lazarettos of Europe, he reports that at Langton Harbor, near Portsmouth, there were on July 8, 1788, three hulks, one of which was a hospital ship. Of the other two he says, " Both the ships were clean, particularly the Ceres. The Fortunee had a few sick in that part called the hospital; but the Ceres had many more sick than the hospital part could contain. Several had the gaol-fever, and a few, petechiae.—Six out of ten that went from Bedford were dead, and two of the others were very sickly and dispirited.

" The gaoler at Reading told me, July 12, 1788, that of the eleven convicts whom he carried on board the hulks, April 1st, 1787, all were dead but three. I have observed, that convicts from the coun-

try often pine away and die without any apparent sign of illness; and that of equal numbers, from the country, and from Newgate, three or four of the former die for one of the latter."

On one of his tours of inspection of English jails and hospitals, he visited the Chester General Infirmary, an institution still in existence, but now called the Chester Royal Infirmary. Of this visit he reports: "The wards are spacious and clean, and the beds not crowded. The two fever wards were not in the least offensive: they were fitted up on the upper floor, on account of a contagious fever in Chester in 1784, and very properly were not cieled, but plastered to the tiles. By the attention of the ingenious Dr. Jaygarth, and his colleague, most of the patients then recovered. The good rules for these wards I here copy:

Rules for the Fever Wards; to prevent the Infection of other patients in the Chester Infirmary.

I. Fresh water and coals are to be brought up to the fever wards every morning; and other necessaries on ringing a bell.

II. No fever patients, nor their nurses, are suffered to go into other parts of the house. No other patient is allowed to visit the fever wards; nor any stranger, unless accompanied by the apothecary or his assistant.

III. Every patient, on admission, is to change his infectious for clean linen; the face and hands are to be washed clean with warm water, and the lower extremities fomented.

IV. All putrid discharge from the patients are to be taken out of the ward as soon as possible.

V. The floors of the wards are to be washed very clean twice a week, and near the beds every day.

VI. All foul linen is to be immediately thrown into cold water; and carefully washed twice out of clear water, in the adjoining room.

VII. Blankets, and other bed and body clothes are to be exposed to the open fresh air for some hours before they are used by another patient.

VIII. All the bed clothes of the fever wards are to be marked Fever Ward, and all the knives, forks, pots, cups and other utensils are to be of a peculiar color, lest they be inadvertently taken among other patients.

IX. All the windows of the fever wards are to be kept constantly open in the day, except the weather be very cold or wet; and some of them should not be shut in the night, if the patients be numerous, and the weather moderate.

X. No relation or other acquaintance can be suffered to take away any linen unwashed, nor other clothes till they have been long exposed to the fresh air.

In 1789, the year before his death, John Howard published a book entitled: An Account of the Principal Lazarettos in Europe, with various Papers Relative to the Plague: together with further Observations on some Foreign Prisons and Hospitals; and Additional Remarks on the Present State of those in Great Britain and Ireland. In the introduction of this work, Mr. Howard says: "In my latest tours, I had with pain observed, that notwithstanding the regulations which had been made in our country, and elsewhere, for preserving health in prisons and hospitals, yet that infectious diseases continued occasionally to rise and spread in them. I had also been led, by the view of several lazarettos in my travels, to consider how much all trading nations are exposed to that dreadful scourge of mankind which those structures are intended to prevent, and to reflect how very rude and imperfect our own police was with respect to this object. It likewise struck me, that establishments, effectual for the prevention of the most infectious of all diseases, must afford many useful hints for guarding against the propagation of contagious distempers in general."—In order to more fully acquaint himself with the subject, Mr. Howard set out towards the end of the year 1785 to visit the principal lazarettos of France and Italy. Not obtaining *from the medical staffs* of these institutions satisfactory answers to his questions concerning the nature of the plague and the best methods of preventing it, he decided to extend his tour to include Smyrna and Constantinople.

"For," as he says, "although the subjects of the Turkish Em-

pire be little enlightened by the modern improvements in arts and sciences, I conceived that from their intimate acquaintance with the disease in question, and from the great difference between their customs and manners, and ours, some practices might be found among them, and some information gained, not unworthy the notice of more polished nations. I also pleased myself with the idea, not only of learning, but of being able to communicate somewhat to the inhabitants of these distant regions, if they should have curiosity enough to inquire, and liberality enough to adopt the methods of treating and of preventing contagious diseases which had been found most successful amongst us."

We shall not take your time to describe any of the Lazarettos Howard visited or to discuss his arguments for the establishment of such quarantine stations in the ports of England. His observations concerning the Plague against the introduction of which by passengers and cargoes from foreign ports these lazarettos were maintained may be of interest. He says: "It may be asked, how it is possible, if the plague be communicated by infected air, that a whole body of men in a town where it rages should be capable of being preserved from it, as is the case with Englishmen in Turkey; and also, why every individual in such a town is not taken with it? In answer to the first of these questions, it may be observed, that the infection in the air does not extend far from the infected object, but lurks chiefly (like that near carrion), to the leeward of it. I am so assured of this, that I have not scrupled going, in the open air, to windward of a person ill of the plague and feeling his pulse. The next question may be answered, by asking why, of a number of persons equally exposed to the infection of the small-pox, or of the gaol-fever, some will not take it? Perhaps physicians themselves are not capable of explaining this sufficiently. It is, however, evident in general, that it must be owing to something in the state of the blood and the constitutions of such persons which renders them not easily susceptible of infection.—The rich are less liable to the plague than the poor, both because they are more careful to avoid infection, and have larger and more airy apartments, and because they are more cleanly and live on better food, with plenty of vegetables; and this, I suppose, is the reason why Protestants are less liable to

this distemper than Catholics during their times of fasting; and, likewise, why the generality of Europeans are less liable to it than Greeks, and particularly Jews.

"The poorer sort of Greeks and Jews use much oil with their food; and this I reckon a disadvantage to them. I have heard of instances in servants in European families, who through imprudence and carelessness, have been attacked with the plague, while the rest of the family have escaped it.

"It is remarkable, that when the corpse is cold of a person dead of the plague, it does not infect the air by any noxious exhalations. This is so much believed in Turkey, that the people there are not afraid to handle such corpses. The governor at the French Hospital in Smyrna told me, that in the last dreadful plague there, his house was rendered almost intolerable by an offensive scent (especially if he opened any of those windows which looked towards the great burying-ground, where numbers every day were left unburied); but that it had no effect on the health either of himself or his family. An opulent merchant in this city likewise told me, that he and his family had felt the same inconvenience, without any bad consequences."

Before leaving on this tour of inspection of lazarettos, Mr. Howard had two of his physician friends, Dr. Aiken and Dr. Jebb, prepare a series of questions concerning the Plague, which he might ask physicians and others qualified to answer them. These questions were:

1. Is the infection of Plague frequently communicated by touch?
2. Does the Plague ever rise spontaneously?
3. To what distance is the air around the patient infected? How far does actual contact, wearing infected clothes, or touching other things, produce the disease?
4. What are the seasons in which the Plague chiefly appears; and what is the interval between the infection and the disease?
5. What are the first symptoms of the Plague—are they not generally a swelling of the glands of the groin and armpits?

6. Is it true that there are two different fevers with nearly the same symptoms, one of which is properly termed the Plague, and is communicated from a distance by the air, and without contact, while the other, which is properly termed contagion, is only communicated by touch, or at least by near approach to infected persons or things?
7. What is the method of treatment in the first stage—what in the more advanced periods—what is known concerning Bark, Snakeroot, Wine, Opium, pure air, and the application of cold water?
8. When the Plague prevails, do the physicians prescribe to those who have the disorder a more generous or a more abstemious diet, and do they prescribe anything to the uninfected?
9. Are convalescents subject to repeated attacks from the same infection?
10. What is the proportion of deaths and the usual length of the disease?
11. What are the means to prevent the Plague, to stop its contagion, and to purify infected places?

These questions he put to Raymond, a physician of Marseilles; Demollin, a surgeon of the same city; Giovanelli, physician of the Lazaretto at Leghorn; They, physician of the Lazaretto at Malta; Morandi, a Venetian physician; Verdoni of Trieste; Fra Luigi di Pavia, Prior of the Hospital of San Antonia at Smyrna; and to a Jew physician. The answers show considerable unanimity of opinion, though, of course, there were differences. Practically all agreed that the disease was communicated by touch, but Dr. They held that it was by respiration rather than physical contact.

As to spontaneous generation, none believed in it save Verdoni, who held that no fevers could be termed contagious, but that they came of themselves. Some of those interviewed held that the degree of virulence was the important factor in communicability but some thought that one was comparatively safe if he kept a few paces away from a plague patient. As to seasonal variations in the prevalance of the disease, spring and summer were reported as the

period in which it was most prevalent. Opinion as to the time between exposure and the appearance of the infection varied from the instantaneous appearance of symptoms to two or three days. Verdoni's comments are the most interesting. He says—"Generally the disease shows itself at the instant of touch, like an electrical shock. Sometimes a person retains the contagious principle without any sensible effect, and after several days communicates it unknowingly to a third, in whom, if predisposed to the disease, it becomes active; otherwise, it may be communicated to others successively, in the same way until it becomes dissipated and annihilated, as happened in Smyrna in 1783. In bodies predisposed it very rarely conceals itself till the third day."

As to first symptoms, some noted swelling of inguinal and axillary glands but others thought that the first symptoms frequently overlooked or confused with those of other disorders, were lassitude, fever, pain in the head, furring of the tongue, etc. As to whether there were two closely related diseases with similar symptoms, but differing in the manner in which they might be communicated, or that the difference was only in degree of virulence, there was no unanimity of opinion.

Treatment varied a great deal and included bleeding, purging, vomiting, and the use of numerous remedies such as bark, ipecac, wine, opium, cooling drinks, vitriolic acid, and the use of suppurative plasters and surgical treatment of the buboes. Verdoni tells of the differences in the treatment used by Christians, Arabs and Jews. He says—"As soon as a Christian finds he has got the Plague, he eats caviare, garlic and pork; drinks brandy, vinegar and the like, to raise the buboes. Upon these he applies greasy wool, caviare, honey of roses, dried figs, etc., to bring them to suppuration. The Turks and Arabs drink bezoar in powder with milk, and other sudorifics, to expel the virus. They vomit and possibly a second time. At Cairo they take opium and cover themselves with mattresses in order to excite sweat; and though parched with heat and thirst, they drink nothing. At Constantinople and Smyrna they eat nothing and drink much water and lemonade. The Jews drink a decoction of citron seeds, lemon or Seville orange peel and their own urine. They abstain scrupulously from animal food."

He also notes the information that had come to him that some sailors in Constantinople in the phrensy of the Plague, had thrown themselves into the sea, and, it is said that on being taken out, they have recovered.

All agreed that there was no acquired immunity, or perhaps that there were relapses. There was no worthwhile opinion as to the mortality rate. As to duration, it was held to range from 24 hours to 21 days. Infected goods were exposed to the air; in some places for as long as 40 days. No one knew of any effective means of protecting one's self against infection, other than the general principles of avoiding exposure and keeping in good physical and mental condition. Infected places were treated by washing, whitewashing and fumigation.

In March 1783, the Plague, which had been raging in various Bosnian and Dalmatian towns, reached the prominent Adriatic port of Spalato, a city of considerable commercial importance. Thereupon, the Proveditor of Spalato assembled the College of Health, laid an interdict on the whole city, shut up the churches and cut off all communication with the rest of the province. By the third of April the contagion had begun to spread throughout the city and its suburbs. On that day there were promulgated Regulations by his Excellency Francesco Falier, Proveditor General in Dalmatia and Albania for the Republic of Venice and Delegate of Health, during the prevalence of the Plague in the city of Spalato. These regulations, thirty in number, provided that no one should go abroad in the city except the heads of families, and they only with the special permission of the authorities. Daily inspection of all houses was provided for. Anyone concealing his own sickness or conniving to conceal another's placed himself under penalty of death. All cases of any kind of distemper found by the inspectors was to be reported immediately to the office of health, the houses immediately quarantined and the patients to be visited by medical professors for the purpose of diagnosis. All churches, synagogues and other places of assembly were ordered closed, but provision was made for the clergy to minister privately to the sick and the dying. All stray dogs and cats, probably their best rat catchers, were to be killed. All deaths were to be reported in order that the bodies might be

examined. All mendicants were to be rounded up and confined in a fort outside the city. Public funds were appropriated to provide food and other necessities to the poor and proper accounting was to be made of their use.

Not satisfied with what he could find out by interviewing those who were seemingly best qualified to inform him concerning the plague, or by visiting the lazarettos, Howard took a bold, or perhaps foolhardy course in order to learn what he could at first hand. In August, 1786, he embarked at Smyrna on a plague infested ship, bound for Venice. He observes that they stopped to trade at various small ports and that few if any precautions were taken to avoid infecting those with whom they came in contact. Chased by a North African pirate, they escaped death or slavery only by a well-directed shot from one of their own guns.

Storms delayed them and it was not until after sixty days from the date of embarkation that they arrived in Venice. Here he, with his baggage, was conducted to the lazarettos. His experiences there are given in some detail in his book, but with less reserve in a letter to his friend, the Rev. T. Smith, written from Vienna on December 17, 1786. We quote from it as follows:

"Various occurrences, as a traveller in an unfrequented path, have happened to me . . . perils by land, perils by water. After a long and dangerous voyage, the immediate confinement in one of he most offensive lazarettos, without chair, table, or a board to lay my bed on, with the dreadful accounts I received of my son, almost broke my steady spirits. . . . Yet I shall hasten home as fast as possible; but as my apartment at the lazaretto was as offensive as a sick ward is at night (the Venetians being very dirty), the walls probably not washed these fifty years, I soon lost all stomach to my bread and tea, and was listless, as I have known several persons to be in similar circumstances by their confinement in our gaols. I talked of lime-whiting my room, but I soon found the prejudices the Venetians have against it; so I privately procured a quarter of a bushel of lime, and a few days after proper brushes. Early one morning before my guard was up, I began with my valet who was sent to light my fires (having determined to lock up the guard, if he opposed me), and slacking the lime at different times, always with

boiling water (my brick walls and ceiling being before brushed down), we washed every part of my room, and afterwards the floor, with boiling water, and finished the job by noon, so that at four o'clock, I drank my tea, and at night lay in a sweet, fresh room; and in a few days my appetite and strength returned. I had before tried washing the walls with boiling water, but it had no effect on the infectious walls, etc.

"I stayed a week after I left the lazaretto, at Venice, and in three days came by sea to Trieste; I found at the former, and at this place, the slow hospital fever creeping upon me, by my long confinement, the whole air of the lazaretto being infected. Mr. Murray, our last ambassador from Constantinople died there of the putrid fever. But the sub-governor of Trieste spared me his easy and good carriage, and I came here last Tuesday, in four nights and five days; three of the former I travelled, but one night I was forced to stop; I am much reduced by fatigue of body and mind; I have good reason to bless God that my steadiness of resolution does not forsake me in so many solitary hours. If my night fever keeps off, I will soon be on the long stride to Amsterdam.

"P. S. Excuse writing, etc., as I wrote early by a poor lamp. what I suffered I am persuaded I should have disregarded on the Lazaretto, as I gained useful information. The regulations are admirable, If they were better kept. Venice is the mother of all lazarettos, but, Oh, my son, my son!

"P. S. The post not going out till this evening, the 19th, I just add that I had a poor night; much of my fever, though quite off now, six o'clock; yet must stop two or three days longer. The mountain air, I hope, will take it off, and I shall get by the light nights. I only want a month's rest, for indeed nobody knows what I have suffered this journey; many weeks dry biscuits and tea; often I have wished for a little of my skimmed milk. Yet I bless God for many comfortable Sabbaths, and my mind steadily approving the object I had in pursuit."

Just what Howard gained by this venture he does not tell us.

Of other communicable diseases, Howard has little to say. He notes the isolation facilities in many hospitals and the venereal wards. Tuberculosis he mentioned on a number of occasions. Com-

menting on the hospitals of the Papal city of Civita-Vecchia, he says—" In this country the physicians are persuaded that the consumption is a contagious disorder. Patients infected with it in hospitals have a separate ward. The same precautions are used to prevent infection as in the plague. When this disorder has been in private houses, the furniture is destroyed, and the rooms are scraped and fumigated before they are again inhabited."

Speaking of the Real Hospital in Madrid, and by the way, he considered that Italy and Spain had the best hospitals in all Europe including England, he says—" The contagion of consumptions is supposed to infect not only the clothes, bedding and furniture of rooms, but also the walls and ceiling. Danger has been apprehended even from the horses of consumptive patients; and for this reason it was thought necessary, in an instance that was mentioned to me, to kill the horse of an officer who had died of this distemper."

Howard's death in Russian Tartary in 1790, was due probably to some infectious disease the exact nature of which is not known He had travelled on this last European journey, which began at Amsterdam, through Osnaburg, Hanover, Brunswick, Berlin, Koningsburg, Riga, St. Petersburg, Warsaw and Moscow. From this latter city he planned to visit the Crimea and later Turkey, where the plague was raging. He reached Cherson, in Russian Tartary sometime in November 1789. Cherson was a garrison town and at that time was filled with Russian officers on leave after the successful assault by their forces of the Turkish fortress of Bender. Shortly after their arrival and subsequent to certain entertainments given in their honor, a fever broke out among the gentry of the neighborhood. Among the victims was a young lady who lived in the country some miles from Cherson. Howard, though not a physician, seemingly had a reputation of being well-informed along medical lines. He was urgently requested to visit this young lady. He was reluctant to do so but did see her on two occasions in the latter part of December. In January, 1790 he received a letter which had been delayed in delivery, begging him to come again. Vexed by the miscarriage of the message, Howard set out at once in a cold rain on horseback. The young lady died the following day. Howard became ill on his return from her bedside. Though the service of

physicians was offered him, he did his own prescribing. Within a day or two of his death, sick as he was, he could take a light-hearted view of the situation. Conversing with an old friend, Admiral Priestman, who was calling on him, he said: "I am well aware I have but a short time to live; and my mode of life has rendered it impossible I should get rid of this fever. If I had lived as you do, eating heartily of animal food and drinking wine, I might perhaps, by diminishing my diet, be able to subdue it. But how can such a man as I lower his diet, who has been accustomed for years to exist on vegetables and water, a little bread and a little tea? I have no method of lowering my nourishment, and therefore, I must die. It is such jolly fellows as you, Priestman, who get over these fevers."

The next day was his last. Thus died John Howard, humanitarian and keen observer.

The historic Blockley "Green House" or Morgue, now, by act of the Philadelphia City Council, the

WILLIAM OSLER MEMORIAL BUILDING

The room with the two windows on the first floor was for many years the autopsy room in which Dr. Osler spent much of his time during his five years in Philadelphia; the corresponding windows on the second floor are in the first "laboratory" of the hospital. It was there that Shakspeare, appointed "Curator" in 1880, subsequently fitted up what may have been *the first laboratory of bacteriology in the city of Philadelphia*. In it, Formad, appointed "Microscopist" in the same year, may also have done some work, though he preferred his own laboratory at the University and may have taken the specimens he studied there.

UNIV. OF MICH.

THE BEGINNING OF BACTERIOLOGY IN PHILADELPHIA

Recollections of what took place before the beginning of the present century, with contemporary portraits and a bibliography of the Literature of that Period

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Foreword

In considering the scientific merits of the work reviewed in this sketch certain facts must not be forgotten. Each epoch must be appraised by its own standards, not by those of later and better informed times; and in that under discussion the sincere efforts of well-meaning men must not be lightly swept aside as puerile and therefore amusing, or condemned as superficial and careless. The whole subject was new; miracles were being performed, as in the cure of diphtheria by antitoxin, and every day new miracles were hoped for and expected.

Scientific laboratory methods had not yet been elaborated; the scientific control of experiments had not been introduced. Things then seemed simple that have since been found infinitely complex. Conclusions as to how things ought to be were based upon what others had already been found to be. If diphtheria and tetanus could be prevented or cured by the serum of immunized horses, why not tuberculosis, glanders, typhoid fever, suppurations? Each was tried, and in each the early uncontrolled experiments seemed to promise success. Little by little and only after many heartbreaking disappointments it was learned that not all diseases are of infectious origin, that not all of the specific agents produce similar toxins, that not all toxins stimulate the production of useful antitoxins. Hope was revived with the discovery of bacteriolytic anti-serums, but only to wane as their expected therapeutic values became problematical. Vaccines were heralded as the final solution, and the future prevention of all infections through their agency was expected, only to disappoint by the discovery of their distinct limitations.

What is still before him the bacteriologist of today has but a dim and confused idea, but ambition and hope will lead him to persistent efforts out of which much of importance and practical use we hope may come. But of one thing he may rest assured, and that is that most of what he does will be reviewed by future generations in the same spirit of smiling indulgence that he now accords to his predecessors of the decade preceding the present century.

It is because Bacteriology has become a great and important subject, far-reaching in its influence in individual and public relations that curiosity has been aroused as to how and by whom its study began. Had it proved but a passing fad, to be shortly abandoned, the question might never have been asked. When the new is first being tried, its destiny cannot be foretold, and no one bothers to record the early efforts. Fortunately the history that we are about to unfold does not go back to antiquity, but only to a half century ago, and the period that it covers is little more than a decade.

Bacteriology in America followed that in Europe, and it is doubtful whether we were honored by the presence of a single entirely independent investigator. Pioneers there were, but they followed the trails already blazed. The single exception may have been Dr. George M. Sternberg, later Surgeon-general of the U. S. Army, who as early as 1880 announced the discovery of a microorganism that he called Diplococcus pasteuri and declared to be the cause of croupous pneumonia.

The great impetus to the study of bacteriology arose in 1881-1882 when Pasteur's previous discoveries were brought to full publicity through his observations and experiments on rabies, and when Koch announced the discovery of the tubercle bacillus, the solid culture media, and the " plate method " of obtaining pure cultures. But although the new technic was quickly adopted by European investigators and resulted in their discovery of a number of new and important pathogenic microorganisms, Americans were slow to profit by it.

It is interesting to try to translate oneself to the decade between 1880 and 1890 and appreciate the difficulties under which they labored who tried to busy themselves with the problems of microorganisms

and disease. Before 1884, when Klein's little book "Microorganisms and Disease" appeared, there was no book in the English language that treated of the subject. It was not until 1886 that Crookshank's "Introduction to Bacteriology" was published. The first American books seem to have been Satterthwait's "Introduction to Practical Bacteriology," eighty-five pages (1887); Senn's "Surgical Bacteriology" (1889); Ball's "Essentials of Bacteriology" (1891); and Sternberg's "Manual of Bacteriology" (1892). The latter was a large and comprehensive work containing the history and theory of the subject, its technic, descriptions of 158 pathogenic and 331 non-pathogenic microorganisms with tabluations for their identification, and a lengthy bibliography. It was a great boon, especially to those unfamiliar with foreign languages.

There were, at the time, no journals devoted to the subject. Baumgarten's "Jahresberichte" began in 1885, the Zeitschrift für Hygiene in 1886, the Centralblatt für Bakteriologie und Parasitenkunde in 1887 and the Annales de l'Institut Pasteur in 1888.

There was no standard apparatus before 1882; no apparatus was made in America until about 1890, and Eimer and Amend, in New York, were the only merchants through whose catalogue knowledge of the apparatus employed by Europeans could be gained and the desired apparatus imported.

It is, therefore, little wonder that few men were correctly informed as to what had been achieved in Europe, very few able to appraise the value of the achievements, and scarcely any able or ready to pursue research in the new field.

The great discoveries relating to tuberculosis and rabies were received in America with unbelievable skepticism, and instead of promoting experiment and investigation, provoked controversy, hostility and ridicule. Instead of looking upon the demonstrations of Pasteur and Koch as important facts, they were dealt with as philosophical speculations that might be overcome by argument. This is well exemplified in the case of Dr. Charles W. Dulles, a well-known surgeon and the secretary of the College of Physicians of Philadelphia, who with no practical experience of rabies, argued in private, in public and in print that the Pasteur prophylaxis against rabies was folly because there was no such disease as rabies in human beings,

that erroneously regarded as such being but a form of hysteria based upon dread of the disease.

Many, some of whom had doubtless endeavored to stain the tubercle bacilli without success, by the complicated method first devised by Koch and Ehrlich, declared either that there were no such things or that if the objects described by Koch did occur in the sputum or tissues, they were only " crystals " or precipitates of the aniline dyes used.

Such were the conditions generally prevailing throughout the United States before Koch announced the discovery of tuberculin and its supposed value in the treatment of tuberculosis, and Behring the diphtheria antitoxin and the " Blutserumtherapie." The probable future importance of these new agents to medical practice aroused such excitement throughout the world that men from all countries, sent by their respective governments, municipalities, universities, hospitals, or going at their own expense, flocked to Berlin in the hope of pursuing courses of instruction in bacteriology under the great investigators, seeing in the hospitals cases of tuberculosis treated with tuberculin and of diphtheria with antitoxin, or, at least, of obtaining some of the precious fluids to take home for the treatment of their patients or for experimental purposes. Berlin was for two years so overcrowded that many arrived there to find no living accommodations, and the supplies of tuberculin and antitoxin long exhausted. But the very atmosphere was so full of enthusiasm that the disappointment suffered in Berlin only stimulated them to seek the laboratories and hospitals of other German universities in which to pursue courses in bacteriology or observe the progress of cases treated by the new methods. Young graduates who had just completed their hospital interneships and had " gone abroad " to study clinical medicine, pathology, surgery, obstetrics or other specialties, and who were scattered among the German universities, acquired such an unforeseen interest in bacteriology that the courses given in all of those institutions had their resources taxed to the utmost to accommodate them. Travelling students meeting friends from home in one or another of the universities they visited, exchanged gossip and information concerning the new technical methods and the best places to work, so that the enthusiasm grew almost without limit and each year a regiment of men returned to their homes provided with

knowledge, books and apparatus, intent upon future bacteriological research. Among them were many Americans, some of whom were to be, if not the pioneers, at least the advance guard of the bacteriologists of Philadelphia, whose work during the next ten years, was to establish the new science as one essential to medical practice, sanitary science, and commerce.

From this it will be seen that the period of the "beginning" of bacteriology in Philadelphia as, probably, in most other American cities, is to be found in the decade from 1890 to 1900, and it is to it that the following pages will be devoted, as the Historic Period.

The subject may be considered under the following captions:

I. Pioneers of the pre-tuberculin period
II. Bacteriology in the University and Medical Colleges
III. Bacteriology and Laboratories in Hospitals
IV. Bacteriology in the Municipal Health Department
V. Bacteriology in Industry
VI. The Philadelphia Literature of the subject

I. The Pre-Tuberculin Period

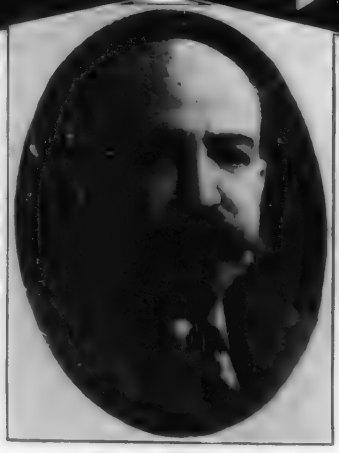
The earliest and most distinguished Philadelphia pioneer was Edward Orem Shakspeare. Born in New Castle County, Delaware, May 19th, 1846, he received his early education at Reynold's Classical Academy in Dover, Delaware. Later he attended Dickinson College, Carlisle, Pennsylvania, from which he was graduated in 1867 and the Medical Department of the University of Pennsylvania from which he was graduated M. D. in 1869.

In 1874, after a short period of general practice in Dover, Delaware, desiring to devote himself to ophthalmology as a specialty he set up in Philadelphia, and shortly distinguished himself by the invention of a new ophthalmoscope "suitable for use for the examination of the eyes of men and animals," and in 1877 was appointed the first ophthalmologist to "Blockley"—the Philadelphia General Hospital. But his interests extended far beyond this limited field and he showed himself to have been an excellent histologist through his contributions to Harrison Allen's "Anatomy," a competent pathologist through studies that resulted in the Toner Lecture "The nature of reparative inflammation in arteries after ligation, acupressure and torsion" (Washington, 1876), and a competent linguist through the translation, from the French, of Cornil and Ranvier's "Pathological Histology," and through the numerous paragraphs from the writings of Koch and other German authors with which he supports his controversial paper "A Criticism of Dr. Formad's printed Statements and Conclusions Concerning the Aetiology of

Edward Orem
Shakspeare

Henry Formad

Lawrence F. Flick



Samuel G. Dixon

Tuberculosis" (1884). In 1880 he was appointed Curator of the Museum, in 1882 Pathologist, and in 1889 Bacteriologist to Blockley.

Shakspeare possessed one of the few really good microscopes (as judged by our present standards) in Philadelphia, with an excellent 1/10" immersion lens. This enabled him to see clearly the results of such bacterioscopic examinations as he made, as compared, for instance, with his chief antagonist Formad who contented himself with what he could see or more often could not see through a 1/5" dry lens of not very good quality.

Every phase of advance in the knowledge of the relation of microorganisms to disease seems to have appealed to him, especially through its relation to the public health. He was the chief of those who investigated and explained the terrible epidemic of typhoid fever that occurred at Plymouth, near Wilkesbarre in the Wyoming Valley in the spring of 1885, in which about 1,200 cases occurred in consequence of the contamination of the water supply.

His knowledge of sanitary science and bacteriology as early as 1885 was such that the United States government appointed him to represent it in an investigation of the cholera in Spain, and in order that his report upon cholera might be more complete he afterward went to Germany and then to India to study it, including his experiences and studies in a voluminous and impressive tome "Report on Cholera in Europe and in India," published by the United States Government (1890).

During the Spanish-American War he was made a Brigade Surgeon, with the rank of Major, attached to the Surgeon-General's office in Washington, and together with Reed and Vaughan, worked out the explanation of the devastating epidemics of typhoid fever that afflicted the U. S. Army camps.

He was a member of many learned societies and was the president of the Philadelphia Pathological Society in 1884. He died of cardio-vascular disease at his home in Rosemont, Pennsylvania, June 1, 1900.

Contemporaneous with Shakspeare was Henry Formad. He was born March 10, 1847 in Scheleznowodsk, province of Caukasus, the son of a merchant who afterward moved to Odessa where Henry was educated and where he studied medicine. He spent a short time in the army as a surgeon, but having been incriminated in a Nihilist's plot was captured and ordered to be shot. He, however, escaped and fled to Germany where he studied at the University of Heidelberg, later coming to America and pursuing additional medical studies at the University of Pennsylvania from which he was graduated M. D. in 1877. That same year he was elected Demonstrator of Pathology in the University. He was appointed "microscopist" to the Blockley Hospital in 1880, pathologist in 1887, and Coroner's physician in 1884. He returned to Europe several times in later years, the last trip being in 1890. He died of uremic blood poisoning June 6th, 1892.

Ernest Laplace was born in New Orleans, Louisiana, July 9, 1861, of French antecedents. He received his education at Georgetown College where

he was graduated A. B. in 1880, and A. M. in 1881, and at the University of Louisiana where he was graduated M. D. in 1884. After a year's residency at the Charity Hospital in New Orleans he went to Paris, Berlin, Vienna and other cities for the enrichment of his medical knowledge. He is said to have been the only American student ever taken as a pupil and assistant by Pasteur. From that great master he brought back a sealed flask of sterile bouillon that has been unopened and has remained sterile all the years up to 1936 when it is still a treasured possession of his son. Later he went to Berlin and worked with Koch upon an acid solution of bichloride of mercury that became known as Laplace's solution.

Upon his return to America, he, in 1888, connected himself in the capacity of demonstrator of pathology with the Tulane University in New Orleans, remaining only a year, when he was called to the chair of pathology in the Medico-Chirurgical College of Philadelphia in 1889 which he held until 1892 when he was elected professor of Surgical Pathology and Clinical Surgery, and in 1896, Professor of Surgery.

In 1891 he was commissioned by the Governor of Pennsylvania to visit Berlin and study the Koch treatment of tuberculosis. He returned enthusiastically interested and proceeded to treat cases of lupus with tuberculin. After a capable career as a surgeon he died May 15, 1924 of heart disease. It is as disappointing as it is interesting to see that he never made any especial use of his training under Pasteur and Koch. He wrote little and not once upon a bacteriological subject.

Although he was not a bacteriologist, even in the most limited sense, it would seem worth while to mention LAWRENCE F. FLICK, at this point. He was born at Carrollton, Cambria County, Pennsylvania, August 10, 1856, received his preparatory education at St. Vincent's College, Westmoreland County, and his medical education at the Jefferson Medical College from which he was graduated M. D. 1879.

Always satisfied of the truth of the "germ theory of disease" he received Koch's discoveries regarding the tubercle bacillus with acclaim and proceeded to make them the foundation stone of a life-long campaign against tuberculosis, the supreme achievements of which were the creation of the Henry Phipps Institute for the Study and Prevention of Tuberculosis and the founding of the White Haven Sanitorium.

These four were men of striking appearance, strong in personality and fearless fighters. Their announced participation in a discussion before a medical society was sufficient to draw a large attendance, but the discussion might have lacked its thrill and excitement had it not been for the persistent antagonism of CHARLES WINSLOW DULLES (1851-1921), a surgeon who was incorrigibly opposed to all that appertained to the "germ theory of disease." He was "rabid" in his attitude toward rabies, whose very occurrence in human beings he emphatically denied, and toward Pasteur and his rabies prophylaxis, the former he regarded as a criminal and the latter as quackery.

It was, indeed, a lively evening when Shakspeare and Formad took opposite sides regarding the tubercle bacillus or Laplace and Dulles argued the pros and cons of the Pasteur treatment. In the former case it was accurate scientific observation silencing random and haphazard opinion; in the latter the ardor of youth and knowledge against prejudice and obstinate ignorance.

Samuel Gibson Dixon was born in Philadelphia, March 23rd, 1851. His early education was pursued at the Mantua Academy and at the Mercantile College. He studied law and was admitted to the bar in 1877. Later he decided to take up medicine as a vocation, entered the Medical Department of the University of Pennsylvania and was graduated M. D. in 1886. In 1887 he went abroad, is said to have worked with Klein, and to have graduated in Bacteriology from King's College, London. Returning to Philadelphia in 1888, he fitted up a laboratory in the Medical Department of the University of Pennsylvania, and began some private investigations in bacteriology. In the same year he was made Professor of Hygiene, but through some misunderstanding with the authorities of the University, resigned in pique and moved with all of his apparatus to the Academy of Natural Sciences where he became Professor of Bacteriology and Microscopical Technology. In 1905 he became Commissioner of Health of Pennsylvania, which position he filled most creditably until his death in 1918.

Dixon, while working with Klein, seems to have been the first to observe "branched" or "forked" tubercle bacilli. How much research he personally conducted is difficult to say as he was a solitary worker. He offered many and sometimes useful suggestions to friends, associates and subordinates, but few of his ideas seem to have been carried out to a conclusion.

To me, he many times complained that he never received credit for his accomplishments, and he undoubtedly believed that he had preceded Koch in the discovery of tuberculin, and was the pioneer in the field of immunization against tuberculosis by the injection of "degreased" cultures of the bacillus, that long anticipated the researches of Calmette and the tests with BCG.

II. Bacteriology in the University and Medical Colleges

In the section just ended it was shown that announcement of the discovery of the tubercle bacillus March 24th, 1882, although it directed the thoughts of American physicians towards the possible contagiousness of tuberculosis, and the more accurate diagnosis of the disease through the demonstration of the bacilli in sputum and in tissue, acted rather as the stimulus for philosophic speculation than for real scientific investigation because of the general lack of technical skill, appropriate apparatus and suitable microscopes.

But when in 1890 Koch announced the discovery of tuberculin and Behring laid the foundation of the "Blutserumtherapie," a new

era set in, and it was then that representatives of the Federal and State Governments, universities and colleges, hospitals and sanitaria as well as many young graduates just out of their hospital internships, hurried to Germany, took courses, provided themselves with Zeiss microscopes and the newest apparatus, and returned ready and anxious to impart their newly acquired knowledge to others and to add to it as much as possible.

Most of the medical colleges of Philadelphia participated directly or indirectly in this movement, but in order to follow its results it will be necessary to take up the institutions one after the other as follows:

A. The University of Pennsylvania
B. The Jefferson Medical College
C. The Medico-Chirurgical College
D. The Woman's Medical College of Pennsylvania
E. The Polyclinic and School for Graduates in Medicine

A. THE UNIVERSITY OF PENNSYLVANIA

Being a large and important institution it contained three departments, the Medical, the Dental and the Veterinary, in all of which bacteriology took on a sudden interest, while it became of great importance in a newly created Laboratory of Hygiene.

a. *The Medical Department.* The catalogue of 1883-4 says of the Medical Department:—" The laboratory is supplied also with a complete outfit of materials and apparatus for investigation of Bacteria in their relation to infectious diseases, and the study of lower fungi in general," but up to 1890 the only bacteriological apparatus to be found in the medical school consisted of odd and ill-assorted pieces, distributed through the rooms of a few professors. Samuel G. Dixon is said by his erstwhile assistant Dr. Seneca Egbert, to have fitted up a laboratory in the medical school in which he worked for about a year (1888-9), when, as the result of an institutional row, he moved it away to the Academy of Natural Sciences in 1891. Henry Formad, in whose rooms some of the apparatus was kept, claimed to have made some laboratory investigations and inoculations with respect to tuberculosis in rabbits, but they must have been of

Juan Guiteras

Allen J. Smith

Joseph McFarland

the crudest type. Shakspeare believed them to have lacked actuality, and been figments of the imagination only, and said as much in print.

I entered the Medical Department of the University, as a student, in 1885 and graduated in 1889, but during those four years never heard a lecture upon a bacteriological subject, made a culture of any kind or was shown a culture of any kind. The sole exercise that might be considered as "bacteriological" was the technic of staining the tubercle bacillus under the direction of Formad, and as he was a skeptic in regard to the relation of the bacillus to the disease, the instruction was but half-hearted, and as the institution provided very poor microscopes for the use of its students (they had been good Zentmayer instruments for their time, which was some ten years before), the results were uncertain.

John Guiteras succeeded James Tyson as Professor of Pathology in 1889-90, and securing leave of absence, in 1890, went abroad for study and the selection of new apparatus for equipping a future laboratory of bacteriology for the instruction of students. During his absence the instruction in pathology and bacteriology was carried on by Henry Formad, assisted by Allen J. Smith. The latter greatly improved the laboratory instruction, especially that having to do with staining the tubercle bacillus. Smith also made cultures of bacteria and discovered a new species which he called *Bacillus caruleus*.

In the same year another of Formad's assistants, J. Leffingwell Hatch, made cultures of bacteria and isolated a micrococcus from the blood of a case of acute hemoglobinuria occurring in the practice of B. C. Hirst.

ALLEN JOHN SMITH was born December 8th, 1863 at York, Pennsylvania. His preliminary education was obtained at the York Academy, and from Gettysburg College from which he was graduated A. B. in 1883. He studied medicine at the University of Pennsylvania from which he was graduated M. D. in 1886. After the usual period as resident physician at "Blockley," in 1886-7, he returned to the Medical Department of the University of Pennsylvania and connected himself with the department of Pathology, his name first appearing in the annual announcement for 1887-8 as Acting Assistant Demonstrator of Morbid Anatomy and Pathological Histology. The next issue, for 1888-9, shows him advanced to the Assistant Demonstratorship, where he remained until 1891 when he accepted the chair of Pathology in the University of Texas.

During the time spent at Pennsylvania he was assistant to Henry Formad

under whom he began making cultures and studying bacteria. He soon excelled his master in the technic.

After years at the University of Texas, where he did much research, chiefly in parasitology, he returned to the University of Pennsylvania (1903) to be Professor of Pathology, and remained there until his death from cardio-vascular disease, at his home in St. Davids, August 18th, 1926.

His most noteworthy contribution was not in bacteriology, but in parasitology, for it was he that first called attention to the American hook-worm as different from the Ancylostoma of the old world.

While in Texas, Smith wrote an excellent little book "Lessons and Laboratory Exercises in Bacteriology" etc., Philadelphia, P. Blakiston's Son and Company, pp. 298, that showed great pains in its preparation.

Among the younger men from the University of Pennsylvania who were taking courses abroad in 1890-1 were Samuel Stryker Kneass and myself of the medical class of 1889. The former had spent a good deal of time at Paris where he availed himself of the courses at the Institut Pasteur; I, at Heidelberg, where I had courses in pathology with Julius Arnold and in bacteriology under Paul Ernst. Meeting in Venice after an Easter Vacation in Italy, Kneass and I went to Vienna where we lived and worked together until we returned to Philadelphia in the autumn of 1891, united by an enthusiastic interest in bacteriology. I at once succeeded in connecting myself in the capacity of Assistant to the Professor of Pathology, with Guiteras, who generously placed as much of the newly purchased bacteriological apparatus as I desired at my disposal, so that I was enabled to equip a laboratory large enough to afford accommodations for myself and my friend Kneass. In less than a year we were earnestly engaged in bacteriological research, Kneass upon the "Bacteriology of the Lacrymal Sac" and I upon "Bacteriology of the Conjunctiva" to appear in the new monograph "Diseases of the Eye" by Norris and Oliver.

It is in the announcement of the Medical Department for 1891-2 that "Bacteriology" appears for the first time, among the subjects to be pursued during the third year, with the statement "one lecture a week for six weeks." Guiteras, no doubt, intended to give this instruction himself, but being a man of easy-going habits, was glad to unload it upon my shoulders and I assumed the burden and continued to carry it for several years, before I was officially made "Lecturer on Bacteriology" in 1895.

Illustrating these six lectures were six laboratory demonstrations upon which anyone of the present generation would look with a good deal of merriment and some misgiving. They began with the preparation of a "hay infusion" and the isolation of the *B. subtilis* (or something similar to it) and ended with the cultivation and inoculation of *B. anthracis* and *B. tuberculosis*, both of which microorganisms were handled by the students with a degree of carelessness that makes me wonder what particular god preserved them from extermination.

In those early days every investigator had to make his own culture media from the crude materials then obtainable, and the laboratory cooking was a large part of the order of the day. There was no small pride taken in the final products, and when visitors were received, as much talk centered about the methods of making and keeping the culture media as about the living microorganisms for whose delectation they were prepared.

In 1896 I resigned from the University to become professor of Pathology and Bacteriology in the Medico-Chirurgical College, my successor being David Riesman who carried on until 1899 when Guiteras was succeeded by Simon Flexner, and A. C. Abbott was made professor of Bacteriology.

JOSEPH MCFARLAND was born in Philadelphia, February 9, 1868. His preliminary education was obtained at the public schools of Philadelphia and at the Lauderbach Academy, and his medical education at the University of Pennsylvania from which he was graduated M. D. in 1889. After serving as resident physician to "Blockley" during 1889-90, he spent a year, 1890-91, in Heidelberg and Vienna, studying pathology and bacteriology. Upon returning he became "Assistant to the Professor of Pathology" (1891), "Assistant Demonstrator of Pathological Histology" (1892), then "Demonstrator of Pathological Histology" (1892) and "Lecturer on Bacteriology" (1895) in the University of Pennsylvania. At the same time (1893) he became Adjunct Professor of Pathology in the Philadelphia Polyclinic and College for Graduates in Medicine, resigning in 1894 to become the Director of the Biological Laboratories of the H. K. Mulford Company. He spent the summer of 1895 at Halle, working upon bacteriological problems in Carl Fraenkel's laboratory under George Sobernheim.

In 1896 he resigned from the University of Pennsylvania to accept the chair of Pathology and Bacteriology in the Medico-Chirurgical College. In 1900 he resigned from the H. K. Mulford Company and became Consulting Bacteriologist to Parke, Davis and Company, continuing until 1910. The summer

of 1903 he spent working with streptococci and pneumococci at the Pasteur Institute in Paris, under Metchnikoff. In 1910 he became professor of pathology in the Woman's Medical College of Pennsylvania, continuing until 1914.

From 1907 to 1910, before the transfer of the Henry Phipps Institute from the original management to the University of Pennsylvania in 1910, he directed the work of its laboratories.

In 1914 the importance of the "full time professorship" was becoming so emphasized that he gave up all outside engagements to devote himself to the Medico-Chirurgical until 1916, and thereafter until the present time (1936) to the University of Pennsylvania that absorbed the former institution by amalgamation.

McFarland wrote a number of books, two on bacteriology—"The Pathogenic Bacteria and Protozoa," and "Fighting Foes too Small to See." The former of these became the most used text book of its period and went through nine editions. After his entrance into the Faculty of the University he no longer had any responsibility regarding the teaching of bacteriology and had his official title reduced from Professor of Pathology and Bacteriology to Professor of Pathology, after which he completely neglected bacteriology.

In pathology his interests have always appertained to that part known as "General Pathology," which he has taught to Medical, Dental, and Veterinary students.

b. *The Laboratory of Hygiene.* In the "Catalogue and Announcements of the University of Pennsylvania" for 1891-92, it is stated that "Through the liberality of a number of citizens of Philadelphia, the University of Pennsylvania has been enabled to establish a Laboratory of Hygiene. A large building, especially planned and fitted for this purpose, is now nearing completion and will be completely equipped and ready for use on February 1, 1892."

Two courses of instruction were announced, I: "A course in Practical Hygiene" and II: "An elementary course in Bacteriology." The latter was to begin on the day that the building opened and continue for eight weeks, five days a week.

The personnel of this new department was mostly recruited from the Johns Hopkins Hospital and consisted of John S. Billings, Director, A. C. Abbott, first assistant, Albert A. Ghriskey, assistant in Bacteriology, and James Homer Wright, "Thomas A. Scott Fellow in Hygiene."

It probably opened at or near the date expected and the next issue of its catalogue (1892-3) gives a list of eleven matriculants of whom

A. C. Abbott

A. A. Ghriskey

M. P. Ravenel

David H. Bergey

three devoted themselves to bacteriology—Samuel Stryker Kneass, Adelaide Ward Peckham and Mazÿck Porcher Ravenel. The success of the department was disappointing, for in its second year there were only six students registered, of whom one, Adelaide Ward Peckham was entered a second time for a newly announced "Course in Advanced Bacteriology." It is in the class of this year (1893-4) that the name of David Hendricks Bergey makes its first appearance. There were also some changes in the Staff, for A. A. Ghriskey's name had disappeared, J. H. Wright had gone, and M. P. Ravenel had been transferred from the list of students to "Thomas A. Scott Fellow in Hygiene." Another year (1894-5) finds Ravenel promoted to "Assistant in Bacteriology" and Bergey to the "Thomas A. Scott Fellow in Hygiene." The same courses in Bacteriology are offered, and the list of matriculants published shows twenty-one students taking them, of whom Robert L. Pitfield is one. In 1895-6 Billings was still Director, Abbott, First Assistant, Ravenel, Assistant in Bacteriology, Bergey had shifted to "Assistant in Chemistry," and there were thirteen students in Bacteriology, among them Lydia Rabinowitsch, Ph. D. In 1896-7 Billings had gone, Abbott had become Director in his place, Ravenel had gone, Bergey had been moved to First Assistant, and twenty students took Bacteriology.

During these five years the only rapprochement between the Laboratory of Hygiene and the Medical Department lay in the fact that Billings, the Director of the former, was the professor of Hygiene in the latter. With his resignation in 1896, Abbott entered the Medical Faculty for the first time as professor of Hygiene. To his title "and Bacteriology" was added for the first time in the Announcement of 1899-90. It seems not to have been until 1903, in the third year of Simon Flexner's incumbency of the chair of Pathology, that Bacteriology was separated from Pathology, transferred from Flexner's to Abbott's jurisdiction, the medical classes sent to the Laboratory of Hygiene for their instruction, and Bergey advanced to the position of Assistant Professor of Bacteriology to look after them.

ALEXANDER CREVER ABBOTT was born in Baltimore, Maryland, February 26, 1860. He received his preparatory education at the Baltimore City College and his medical education at the University of Maryland, where he was graduated M. D. in 1884. He later enjoyed the privilege of association as a

Laboratory of Hygiene, University of Pennsylvania

Bacteriolergical Class Room, Laboratory of Hygiene,
University of Pennsylvania

special student with the founders of the Johns Hopkins Medical School, and still later did some studying at Munich and Berlin. He was brought by Billings from the Johns Hopkins Medical School to the University of Pennsylvania to be the "Assistant in Hygiene" of the newly organized laboratory. In that position he remained until 1896 when he became Director of the Laboratory of Hygiene and Bacteriology and in that capacity he continued to serve the University until 1928 when, having reached the retiring age, he was made emeritus professor.

He was the author of two books, "Principles of Bacteriology," that appeared in 1892 and went through many editions, and "The Hygiene of Transmissible Diseases" (1899). Both were small books and in preparing subsequent editions their author seemed oblivious of the fact that the expansion of the subject necessitated increased space to properly accommodate it. The result was their diminished popularity and usefulness.

Although provided with every facility for the prosecution of research in Bacteriology, Abbott devoted himself to administrative duties both in connection with the laboratory of Hygiene and the Philadelphia Board of Health and eventually dropped the subject altogether.

He died September 11th, 1935.

Albert A. Ghriskey was born in Philadelphia in 1859. He received his preliminary education at Professor Hasting's West Philadelphia Academy. He studied medicine at the University of Pennsylvania, from which he was graduated in 1880, interning both at Mercer Memorial and Children's Seashore Home at Atlantic City. He went to the Johns Hopkins Hospital under William Osler and must have interested himself in bacteriology as in 1892 he was a conjoint author with Hunter Robb, of a paper "The Bacteria of Wounds and Skin Stitches" that appeared in the Bulletin of the Johns Hopkins Hospital (3: 37: 1892).

In 1892 he returned to Philadelphia to become "Assistant in Bacteriology" in the original personnel of the Laboratory of Hygiene as organized by Billings, but remained only a year.

He died December 28th, 1935, and in the obituary notice published in the Pennsylvania Medical Journal, it is stated that he "joined the bacteriological staffs of the Pennsylvania and Episcopal Hospitals of Philadelphia." He became a Fellow of the College of Physicians of Philadelphia in 1892.

Mazÿck Porcher Ravenel. Born at Pendleton, South Carolina. He received his preliminary education at the University of the South from which he was graduated in 1881, and his medical education at the Medical College of the State of South Carolina, from which he was graduated M. D. in 1884.

In 1892 he came to Philadelphia and matriculated in the first class to be taught in the new Laboratory of Hygiene of the University of Pennsylvania. It seems that bacteriology proved a congenial vocation to him, and he pursued its study with enthusiasm and advanced accordingly. In 1893-4 he was the

Thomas A. Scott Fellow in Hygiene, and in 1894-5 became Assistant in Bacteriology. After spending the summer of 1895 at the Pasteur Institute at Paris and the Hygienisches Institut at Halle in Saxony, Germany, he removed to the Laboratory of Hygiene at Princeton of which he became the director. In 1897 he became bacteriologist to the State Live Stock Sanitary Board of Pennsylvania, then housed in the Veterinary Department of the University, and in 1898 was made Lecturer on Bacteriology in the Veterinary Department of the University of Pennsylvania, continuing until 1903 when he resigned to become the Assistant Medical Director and Chief of the Laboratories of the newly founded Henry Phipps Institute for the Study and Prevention of Tuberculosis, partly in whose interest he went to Génoa and spent some months at the Maragliano Institute.

In 1907 he accepted the position of Professor of Bacteriology in the University of Wisconsin, where he remained until 1914 when he accepted the position of Professor of Preventive Medicine, Medical Bacteriology and Director of the Public Health Laboratory in the University of Missouri, where he continues to live after retirement from the University position on account of age.

Ravenel considers that his most important achievement was the proof of the transmissibility of bovine tuberculosis to man, work that he began under Leonard Pearson at the University of Pennsylvania, and continued later elsewhere. It was the subject of a paper read before the International Congress on tuberculosis held in London in 1901 in which Ravenel took issue with Koch.

Laboratory workers are indebted to him for an excellent method of preparing agar-agar media, for a "potato cutter" for making half cylinders of potato to be used as culture media in test-tubes, and for a platinum culture transfer wire fastened into an aluminum handle and covered with a glass tube protector so as to be carried in the pocket.

David Hendricks Bergey was born at Skippack, Pennsylvania in 1860. His scientific and medical studies were pursued simultaneously in the Medical Department and the Course Auxiliary to Medicine of the University of Pennsylvania and he was graduated with both the M. D. and B. S. degrees in 1884. In 1893-4 he matriculated in the Laboratory of Hygiene and after a year of study was made Thomas A. Scott Fellow in Hygiene; in 1895-6 he was Assistant in Chemistry, and in 1896-7, when Abbott succeeded Billings as director of the laboratory, Bergey was advanced to First Assistant. In this position he remained until 1903, when the teaching of bacteriology to medical students was transferred to the Laboratory of Hygiene, and he was made Assistant Professor of Bacteriology. In 1916 his title was changed to Assistant Professor of Hygiene and Bacteriology, and upon the retirement of Abbott, in 1926, he was made Professor of Hygiene and Bacteriology continuing until 1931 when he was retired on age, and connected himself with the National Drug Company, with which he has remained to the present time.

In 1901 appeared "The Principles of Hygiene" by D. H. Bergey, published by W. B. Saunders Company of Philadelphia, a book that was of such merit that it held its field for twenty years and passed through seven editions. While this work brought its author deserved distinction, it is probable that he will be much longer remembered for a laborious piece of work done as chairman of a committee representing the Society of American Bacteriologists, whose other members were Francis C. Harrison, Robert S. Breed, Bernard W. Hammer and Frank M. Huntoon, known as "Bergey's Manual of Determinative Bacteriology." It harmonizes the old and new nomenclature of microorganisms, arranges them according to the modern classification and gives elaborate tables for the identification of all species that have been described.

c. *The Dental Department of the University of Pennsylvania.* From the minutes of the Faculty of the Dental Department of the University of Pennsylvania for March 3rd, 1896, the following extract is taken:

> "Believing that a sufficient knowledge of Bacteriology is essential to a proper education of a dentist, it is recommended that the Trustees provide for a semi-popular course of about six lectures to be given to the senior class of the Department of Dentistry as soon as possible during the present session, which course should not be obligatory or include a final examination. But for the ensuing year and thereafter, it is recommended and requested that instruction both in didactic and in laboratory work shall be given to the third year dental students, in Bacteriology so far as it is adapted to their needs, and that the study of it be made an obligatory part of the third year curriculum."

An arrangement was therefore made with the Laboratory of Hygiene by which the instruction in the subject would be directed by A. C. Abbott, and an announcement of that fact was printed in the catalogue for 1897-8. The announcement for 1898-9 shows Bacteriology taught only in the third year of the course for two three-hour periods per week.

Things continued in this general fashion until 1903-4 when Abbott was announced in the catalogue to be "away on public business" and D. H. Bergey appeared on the faculty list as Assistant Professor of Bacteriology. He later continued in that capacity but in 1905-6 was succeeded by Nathaniel Guildersleve who had long prepared for the position, being in 1898-9 and 1899-1900 a student in the Laboratory of Hygiene, in 1900-1 the Scott Fellow, in 1901-2 First

Assistant in Bacteriology, in 1902-6 Assistant in Bacteriology in the Laboratory of Hygiene.

d. *Bacteriology in the Veterinary Department of the University of Pennsylvania.* In the Annual Catalogue and Announcement of the Veterinary Department of the University of Pennsylvania for 1896-7 Bacteriology seems to make its first official appearance as "Practical Bacteriology," to which Tuesday and Wednesday afternoon after 4 o'clock were devoted after February first in the second year, and Mondays at 11 o'clock before February first for the third year. Guiteras was professor both in the Medical and Veterinary Departments at that time, but the announcement does not state where or by whom the instruction was given. In 1897-8, the "Roster" for the third year lectures etc., shows a lecture hour for bacteriology under Guiteras' name on Mondays at 11 a. m., but no laboratory hours.

In 1898-9, M. P. Ravenel's name appears for the first time on the Faculty list as "Demonstrator of Veterinary Bacteriology." Guiteras had given up the bacteriology, but continued to teach Pathology and Morbid Anatomy. At the end of the year Guiteras resigned to return to his native land, Cuba, now freed from the yoke of Spain, to become professor in the University of Havana and president of the Supreme Board of Health of Cuba. Simon Flexner succeeded him as Professor of Pathology in both the Medical and Veterinary departments.

In 1899-1900 Bacteriology appears in the "Roster" of the second year on Thursday at 10 a. m. with an asterisk referring to a footnote that states "The lectures are held in the Medical Department." As Abbott was at that time Professor of Hygiene and Bacteriology in the Medical Department, it may be presumed that the lectures were delivered by him and the laboratory instruction conducted in the Veterinary Department by Ravenel. This arrangement was probably unsatisfactory both to the didactic and practical instructors, for it continued but two years when in 1903-4, Ravenel resigned and Bergey took his place as Assistant Professor of Bacteriology.

B. THE JEFFERSON MEDICAL COLLEGE

It is very difficult to determine the beginnings of Bacteriology at the Jefferson Medical College because all of those concerned are now

W. M. L. Coplin

Alonzo H. Stewart

View of one-half of the Bacteriologic Laboratory, showing the individual desks, incubators, projection apparatus, etc.

dead. In a "Class-book" for 1892 the late W. M. L. Coplin is said to have "Given a lecture on Hygiene and Bacteriology." In 1893 J. M. DaCosta and D. Brandon Kyle conducted a private clinical laboratory in which bacteriological examinations were made, and some private instruction given; but it was not part of the college course.

In the catalogue of the college for 1895 there is mention of one lecture a week and one demonstration a week in "Bacteriology and Clinical Microscopy" in the second year. Presumably these were given by Coplin, assisted by Alonzo H. Stewart as Demonstrator of Clinical Microscopy. The next year Coplin accepted a professorship in the South, and Stewart carried on the instruction until Coplin returned to be Professor of Pathology and Bacteriology in 1896. But it was not until 1896 that regular instruction in Bacteriology began. In 1909 the chair was divided and Randle C. Rosenberger became Professor of Bacteriology to the present time.

ALONZO H. STEWART was born at Greensburg, Pa., in 1867. He graduated from the Greensburg High School in 1885, then attended the Greensburg Seminary and the Indiana Normal School. He studied medicine at the Jefferson Medical College, Philadelphia, where he was graduated in 1892. After serving as a resident physician at "Blockley," he became Demonstrator of Clinical Microscopy in the Jefferson Medical College from 1894 to 1896. Later he became bacteriologist to the Bureau of Health of Philadelphia and Adjunct Professor of Bacteriology in the Philadelphia Polyclinic and College for graduates in Medicine.

He made a very important contribution to bacteriological technic, viz., the Stewart "Cover-glass forceps." This instrument was invented in 1895, in the days when bacteria were always stained upon cover-glasses, instead of the slides as at present. Only those who have experienced the facility with which capillary attraction can draw the staining solution between the blades of ordinary forceps from the cover-glass upon which it has been dropped to the fingers, can appreciate this boon.

C. THE MEDICO-CHIRURGICAL COLLEGE

It was in 1889 when Ernest Laplace was working with Pasteur in Paris, that William Pancoast, founder of the Medico-Chirurgical College, and its professor of Surgery, paid a call upon the great master, consulted him about the future of pathology and bacteriology in medical colleges and asked his advice as to the proper choice of a professor of those subjects. Pasteur after listening carefully to what

Ernest Laplace

Ernest Brewster Sangree

he had to say, introduced Laplace and recommended him for the position.

The professorship to which Laplace was soon after elected, and which he moved to Philadelphia to fill, was purely didactic. There were no laboratories and there was no apparatus. But he rose to the situation as well as he could by the use of his own microscope, through which he showed the students some specimens of pathological lesions and stained bacteria.

With the hope of enlarging the resources and providing future assistance, he chose a recent graduate named Sangree to be his "demonstrator," and proceeded to give him personal instruction in both pathology and bacteriology.

ERNEST BREWSTER SANGREE was born May 28th, 1862 in Huntington County, Pennsylvania, and received his preliminary education in the public schools and Mercersburg College, later attending Franklin and Marshall College. His medical education he pursued at the Medico-Chirurgical College of Philadelphia, from which he was graduated M. D. in 1889. He assisted in the teaching of Pathology and Bacteriology in the Medico-Chirurgical College from the time of his graduation to 1895 when he resigned to become the professor of Pathology and Bacteriology in the Vanderbilt University, where he remained until 1899, when ill with pulmonary tuberculosis he resigned, moved to Chicago, and died February 22nd, 1900. He was also assistant visiting pathologist to Blockley Hospital from 1892 to 1895.

While a cheerful personality and a devoted teacher, Sangree was not a writer, and the very few titles bearing his name deal with other than bacteriological subjects.

In 1896 Laplace changed to the professorship of Surgery, Sangree had gone, and Joseph McFarland was elected to the chair of Pathology and Bacteriology. The latter appointment marked a new era for the Medico-Chirurgical College, for it was accompanied by the establishment and equipment of modern laboratories for both pathology and bacteriology with excellent microscopes for all of the students and a suitable and complete bacteriological outfit that enabled the students to make and sterilize their own media, plant their own cultures and perform all of the usual staining methods. With the erection of a new laboratory building a few years later, Robert L. Pitfield was appointed Demonstrator of Bacteriology.

D. THE WOMAN'S MEDICAL COLLEGE OF PENNSYLVANIA

There seems to have been no research or instruction in Bacteriology in the Woman's College until 1896, when Lydia Rabinowitsch was elected "Director of the Bacteriological Laboratory." She con-

Lydia Rubinowitsch

Adelaide Ward Peckham

ducted the department for three years, then resigned, returned to Berlin to work upon tuberculosis in milk and butter at the Koch Institute, where she met and married Walther Kempner.

The following appeared in the J. A. M. A., October 12th, 1935:

> "Frau Prof. Lydia Rabinowitsch-Kempner, for many years editor of the tuberculosis journal and well known for her researches on tuberculosis, has died in her sixty-fourth year. She was the only female co-worker of Robert Koch. Later (from 1896 to 1899) she served as instructor in bacteriology at the Woman's College in Philadelphia. Afterward she accepted Koch's invitation to do research, in the Koch Institute, on the occurrence of tubercle bacilli in butter and milk, on serum reactions in human and bovine tuberculosis, and on kindred subjects. From 1920 to 1933 she was the director of the Bacteriological Institute in the Krankenhaus Berlin-Moabit, until, in 1933, under the new regime, she was forced to retire."

The next incumbent was ADELAIDE WARD PECKHAM who was born in Brooklyn, Connecticut, March 31st, 1848, of ancestors who left Europe on account of religious persecution and came to this country in 1630. She received her preliminary education in the public and private schools of Connecticut, and her medical education at the Woman's Medical College of Pennsylvania, where she was graduated M. D. in 1902. She seems to have had a very early interest in hygiene and bacteriology, and, as has been shown, was one of the matriculants of the first class admitted to the Laboratory of Hygiene of the University of Pennsylvania, remaining several years as a student and research worker in that institution. She was elected Associate Professor of Pathology in charge of Bacteriology, in 1898, and advanced to Professor of Bacteriology in 1899, remaining in the chair until 1919. She is still living in East Orange, New Jersey.

E. THE POLYCLINIC AND COLLEGE FOR GRADUATES IN MEDICINE OF PHILADELPHIA

As all those who might have remembered seem to have died, as the office of the Graduate School of Medicine of the University of Pennsylvania that took over the "Polyclinic" in 1916 possesses no announcements of the Polyclinic for the approximate dates, and as the Faculty Minutes seem to have been lost, it is impossible to be accurate as to dates. But the writer of this sketch remembers that one afternoon, some time in 1893 or 1894, when he and S. S. Kneass were working in the former's private laboratory in the Medical Department of the University of Pennsylvania, a Dr. Stern entered

and began a conversation upon the necessity of building, equipping and manning laboratories of pathology, bacteriology and chemistry for the Polyclinic College.

The outcome of that conversation was the election, shortly afterward, of Samuel Stryker Kneass, Adjunct Professor of Bacteriology and Joseph McFarland, Adjunct Professor of Pathology. For some time there were diagrams and blue-prints of rooms and furnishings, then the consummation of the project and the new laboratories were opened. We had almost everything but money, assistants, animals and students. With no salaries the incentive to work was slight; with no hired help to make culture media, cut sections, or mount museum specimens, very little could be achieved, and with no one to care for them, it was impossible to keep animals for research. Furthermore, without students it was impossible to teach.

I often look back with regret and humiliation at those two or three years of a professorship without opportunities, without duties and without salary. During all the time that I held that position, although I endeavored to have everything necessary ready for the occasion, I never had a single student to teach. Kneass, however, was a little more successful, but by the time he had a real class, a better opportunity at the Pepper Clinical Laboratory called him away and at about the same time I resigned because of my new connection with the Laboratories of the H. K. Mulford Company.

So the beginnings of Bacteriology and Pathology at the Polyclinic were amusing as well as discouraging. Kneass was succeeded in 1896 by Dr. H. D. Pease who remained only two years before he resigned to join Roswell Park and Harvey D. Gaylord in cancer research in Buffalo, and I was followed in the same year by Thomas S. Kirkbride.

III. Bacteriology and Laboratories in Hospitals

A. The Pepper Clinical Laboratory of the University Hospital

The founding of this laboratory in 1894 was immediately followed in 1895 by the erection of a commodious and well adapted building to house it. It was equipped with the most modern apparatus for chemical, bacteriological and clinical investigation.

THE PEPPER CLINICAL LABORATORY OF THE UNIVERSITY HOSPITAL

Samuel Stryker Kneass

The Pepper Clinical Laboratory

Alfred Stengel, its first director, selected Samuel Stryker Kneass, his friend and former classmate, to conduct the laboratory of bacteriology. Kneass, therefore, left the medical department of the University, where he had maintained a loose connection, the Polyclinic and College for Graduates in Medicine where he had been but a short time Adjunct Professor of Bacteriology, and the "German" (now Lankenau) Hospital, where he acted as bacteriologist, and took up his quarters in the Pepper Laboratory in which he remained for thirty-three years, an earnest worker and a source of inspiration to generations of University Hospital internes until the time of his death on December 8th, 1928, at the age of sixty-four years.

SAMUEL STRYKER KNEASS was born in Philadelphia, January 16th, 1865. He received his preliminary education at the Faries Academy, at a summer school in Vevey, Switzerland, and in the College of the University of Pennsylvania, where he was graduated A. B. in 1886. His medical studies were pursued at the same institution, from which he was graduated M. D. in 1889. After having interned for the customary year at the University Hospital, he went to Paris where he took various courses — one in bacteriology at the Institut Pasteur.

Kneass was a curiously modest and reticent man. He had learned French in his boyhood during his summers at school in Vevey, but would never speak it if he could avoid it; he learned German in school, at college, and during a vacation in Berlin. The author lived with him one summer in Vienna and cannot remember ever having heard him speak German to anyone. Although a well-trained and expert bacteriologist, constantly busying himself with new and interesting problems, he seems to have written very little except the "Bacteria of the Lachrymal Sac" for Norris and Oliver's "Diseases of the Eye"; a "Note upon the Agglutination and Pathogenicity of the Bacillus subtilis," in collaboration with Joseph Sailer, and "The Quantitative Relations of Antigen, Amboceptor and Complement in the Estimation of Hemolysis" in collaboration with Joseph Evans. It may have been modesty or it may have been indolence that brought about this dilettanteism, but back of it there was lack of the necessity that spurs most men to action. He inherited sufficient money to enable him to enjoy an easy life, and he never married.

It is melancholy to think that so charming and capable a man, after many years of useful activity should be doomed to such early oblivion. In his "Memoir" Herbert Fox says of Kneass "While Dr. Kneass had no classes, there is a group of about twenty men whom he taught as they worked in the Pepper Laboratory. Every one is a better man, a better doctor, and a better bacteriologist for his teaching."

Laboratory, City Hall

Benj. Meade Bolton

Herbert D. Pease

IV. Bacteriology in the Municipal Health Department

Until the winter of 1894-5 the health authorities of Philadelphia had shown little interest in the public health apart from small-pox. The inhabitants of the city contentedly drank the diluted sewage of the Schuylkill river directly pumped into their water pipes, and died, in large numbers, of typhoid fever. Milk from any source was brought to kitchen doors in pails and measured into pitchers in the quantities required, at four or five cents a quart—sometimes " on the turn " when delivered. Leonard Pearson was laboring earnestly to direct the public attention toward the extermination of tuberculous cattle with but little success and in spite of the earnest voice of Lawrence F. Flick, no attention was paid to the evidence that human tuberculosis was a communicable disease. No city laboratory of bacteriology was maintained. The discovery of tuberculin did nothing to interest the authorities, but with the announcement of the discovery of the diphtheria antitoxin there came a public clamor for a bacteriological laboratory to which cultures from the throats of diphtheria suspects could be sent for diagnosis without expense to either doctor or patient, soon followed by a demand for free antitoxin for the treatment of the poor as the German serum was expensive and the domestic supply very limited. New York already had its city laboratory, under William H. Park, at work upon all phases of bacteriological service, and was making diagnosis and furnishing excellent serum of its own manufacture for the treatment of diphtheria. It was also felt that more attention should be paid to the bacteriology of water,—Abbott was urging that,—and to milk,—George Woodward was urging that. Doubtless the authorities would have yielded to the demands of the Philadelphia profession for a laboratory and for free antitoxin at an earlier date had it not been for the violent opposition of William M. Welch, the Chief Diagnostician of the City Board of Health.

I have never had any interest in the political affairs of the city of Philadelphia, and at the time under consideration, was far too busy to be attracted by what was brewing. For such details as I have been able to collect, I am under obligations to Herbert D. Pease, from whose letters in answer to my questions I quote the following extracts:

"Some time during the winter of 1894-5, after a year of graduate work with Welch and as a laboratory assistant to Flexner at the Johns Hopkins Medical School, I noticed one day an announcement that a Civil Service Examination would be held in Philadelphia for the positions of Director and two Assistant Bacteriologists for the Laboratory of Hygiene to be established in connection with the Bureau of Health of the City of Philadelphia."

"B. Meade Bolton, a graduate of the University of Virginia with subsequent training at Göttingen was at the time Instructor in Bacteriology in the Graduate Department of Medicine, and also in the then newly instituted Undergraduate Medical Department of the Johns Hopkins University. I had been associated with him in giving those courses, and immediately consulted him with respect to the announcement, and was interested to learn that he proposed to take the examination for the position of Director. He suggested that I also take the examination for one of the assistantships."

"The Civil Service Examination comprised tests both written and oral, and was held by E. O. Shakspeare, W. M. L. Coplin and Seneca Egbert, M. P. Ravenel supervising that phase of the examination that called for the identification of cultures of microorganisms."

Many took the examination for the positions, but the choice went to Bolton for the Directorship, Pease for the first assistantship in bacteriology and W. J. Gillespie, a graduate of the Jefferson Medical College, the second.

"Our activities began, as I remember, in May 1895 in rooms on the seventh floor of the City Hall, commonly known as the 'attic'."

"The primary scope of the work was the development of the bacteriological diagnosis of diphtheria, the production of diphtheria antitoxin and the conduct of general bacteriological work such as might be called for by the activities of the Bureau of Health."

"The President of the Board of Health at that time was William H. Ford, a local practitioner of outstanding integrity and reputation."

"There already existed at the time of the creation of the Laboratory of Hygiene, a Chemical Laboratory for the Bureau of Health, presided over by a chemist named Robinson, occupying quarters next door."

"The horses employed in the production of the diphtheria antitoxin were located at a Fire Department Station at Frankford. After about a year they were moved to a larger and more commodious Fire Station in West Philadelphia."

"Some of our early activities in the Bureau comprised, in addition to the work in diphtheria and the antitoxin production, studies on the action of antiseptics, investigations for the Coroner's office, and bacteriological examinations of samples of water from both the Delaware

and Schuylkill Rivers for the Bureau of Water in the Department of Public Works. This Department was then under the supervision of the nationally known engineer, Mr. Trautwine."

"I mention this especially because it was by reason of my activities in connection with these studies of the water supply that we were able to work out the cause of the very large outbreak of typhoid fever in Philadelphia in the year 1897. It was shown to have been due to an overflow of an intercepting sewer as it passed over the Wissahickon Creek just above the Queen Lane pumping station of the Water Department."

"During the time I was connected with the laboratory we also made still more extensive studies of the pollution of the two rivers supplying the city with the then unfiltered and untreated surface waters."

Bolton resigned as Director in the autumn of 1896 to maintain his self-respect and scientific reputation which were threatened through a politico-commercial scheme in which it was attempted to involve him. The second assistant, Gillespie, became the victim of a scheme promoted by a Connecticut Yankee named Wolf by which "Electrozone," a hypochlorite solution made by the electrolysis of sea-water, and possessed of a very slight bactericidal property, was to be certified by the laboratory, and marketed commercially. Taking advantage of the absence of the director of the laboratory on his summer vacation, a laboratory for this special work was fitted up in the basement of the City Hall, tests were made, and a report giving some bactericidal power to the preparation, made by Gillespie, was seized upon for exploitation. Just as all this had been consummated, Bolton returned and protested to the authorities with such emphasis that he became *persona non grata* and resigned, in February 1897, to be succeeded by A. C. Abbott.

"With the appointment of Abbott as Director, the work of the laboratory was expanded to include the Widal test for the diagnosis of typhoid fever, this phase of activity being placed in the hands of Alonzo H. Stewart, well remembered for his invention of the 'cover-glass forceps'."

"I would like to pay tribute to his work which was most careful and painstaking, and resulted in the establishment of a Widal diagnostic service second to none that I have ever known. He followed up the doubtful cases clinically and at a time when he had collected the results of 35,000 determinations, the Widal test and the clinical diagnosis were harmonious in over 98% of the total number of cases."

After Bolton's resignation Pease remained but a short time, spent another short period as Instructor of Bacteriology in the Philadelphia Polyclinic, then accepted a position in the State Laboratory for Cancer Research under Roswell Park and Harvey R. Gaylord at Buffalo.

Pease was succeeded by Gillespie who was in turn replaced by Alonzo H. Stewart.

With the disappearance from the laboratory of all of the members of its original staff, it may be as well to leave it.

V. Bacteriology in Commerce in Philadelphia

I have forgotten the exact date, but it was sometime in the late autumn of 1894, when I was Demonstrator of Pathological Histology and Lecturer on Bacteriology in the Medical Department of the University of Pennsylvania and Adjunct Professor of Pathology in the Philadelphia Polyclinic and College for Graduates in Medicine, that I was called upon one evening, at my home, by Milton Campbell and H. K. Mulford, the president and secretary, respectively, of the H. K. Mulford Company, Pharmaceutical Chemists and manufacturers of compressed tablets, and offered an amazing proposition.

It was that I should undertake to organize and direct for their company, a " Laboratory of Biology " for the manufacture of such products as the antitoxins for diphtheria and tetanus, tuberculin and various vaccines. There were no " full-time " teaching positions in medical colleges in those days, and it was explained that the new activity need not in any way interfere with what I was already doing, but should occupy my spare time. After mature deliberation and definite understandings regarding many things, I agreed to accept. As a matter of interest it seems worth while to state that no contract was signed; it was an understanding between gentlemen, and all that had been agreed upon was faithfully carried out by all parties concerned.

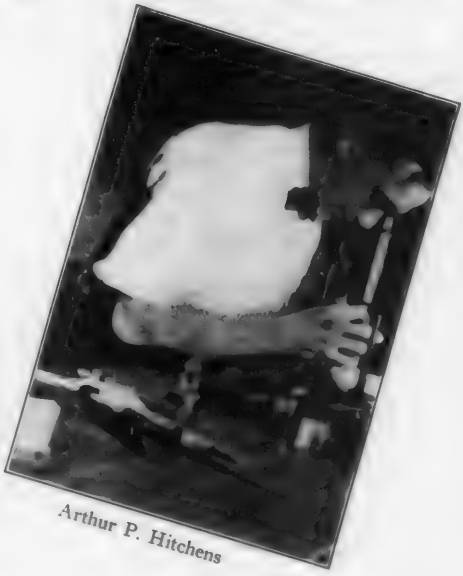
The demand for antitoxin serum was rapidly growing and from the commercial point of view it was imperative that a start be made at once. A large stable situated at Thirty-ninth and Egglesfield, now Cambridge, streets in West Philadelphia was rented, thoroughly cleaned and white-washed, and part of the second story front closed in by partitions to make a laboratory with the necessary adjacent

Biological Laboratory

Bacteriological Laboratory

Animal Room

Clarence W. Lincoln



Arthur P. Hitchens

incubation room, etc., and another part cut off for accommodating the necessary small animals. When completed, the rooms were sightly, seemed adequate and comfortable, and of their appropriateness little question was raised. But the difficulties to be overcome were indeed great!

We started off with a staff composed of myself as Director, Clarence W. Lincoln, Assistant, and John Adams, Professor of Surgery in the Veterinary Department of the University as Veterinarian. Not one of us had ever performed any of the tasks confronting us. It was necessary to find out both what to do and how to do it, and I shall never be able to express my obligations to William H. Park of the Health Department of the City of New York for the advice and cultures he gave me! I also profited from conversation with Dr. Gibier of the Pasteur Institute in New York City, and from permission to see his apparatus at work.

Consider that our first requirement was virulent diphtheria toxin in large quantities and that it was not then known whether all cultures of diphtheria bacilli produced uniform toxin. Those with which we began seemed to produce none. The most appropriate composition and pH of the culture media had not been worked out, and we took months to determine them. We organized a first rate kitchen department for the preparation of bouillon and other media, and we had had a very large incubating oven made. For the first month or two we endeavored to grow the diphtheria cultures under conditions of continuous aeration devised by Fernbach. That is, they were planted in bouillon contained in broad flat bottom flasks with two lateral tubular apertures in addition to the usual neck. All three apertures were closed with cotton plugs and sterilized. The flasks were filled and inoculated through the vertical neck which was then tightly closed with a rubber stopper above the cotton plug, and a system of sterile rubber tubes attached to the lateral apertures connecting flask with flask, was finally connected with a suction pump outside of the incubator, the purpose of which was to keep fresh sterile air constantly passing over the surface of the liquid upon which the growth of the diphtheria bacilli took place.

The importance of expedition has been emphasized, but almost everything that we did seemed destined to retard our progress. These flasks, for example, had been carefully described to a glass-

blower, who agreed to make them exactly according to a diagram and received an order for a large number, the first installment of which was to be delivered on a certain day.

Instructions were given to the "diener" that so soon as the flasks arrived, they were to be washed, plugged, sterilized, filled with bouillon, autoclaved, and made ready for inoculation and installation in a series of twelve in the incubator. Allowing time for all to be ready, I arrived late in the afternoon to make the inoculation, to find that although all filled and ready the flasks could not be used because the side apertures had been made so short, so tapering and so curved, that no cotton stoppers could be properly inserted, and no rubber tubes attached to them. When, after days of delay, new and proper flasks were obtained and a whole series was inoculated and finally installed for incubation, it was only to find flask after flask become contaminated and its contents ruined.

Of course the fault was with the atmosphere of that stable, a place in which no bacteriological work should ever have been attempted. When we abandoned the cultivation under ventilation for the usual method, we still lost at least thirty per cent of our cultures by contamination. The worst of all contaminations was by the tetanus bacillus whose spores abounded. It became necessary carefully to examine every culture with special reference to tetanus bacilli which we frequently found. It was probably sometimes present when we did not find it, for the horses injected with the toxin occasionally acquired tetanus and died—sometimes when far along in the course of immunization and of great value.

But we persisted, exerted extraordinary precautions, learned what to do and how to do it step by step until by the early summer of 1895 it was possible for the company, who had announced its expected advent, to offer its first antitoxin for sale, in good hope of a future constant supply that happily never failed. The company rewarded me and also benefitted themselves on that occasion by giving me four months' absence on full pay to go abroad to visit other laboratories and see how others worked. I learned many things and visualized many future improvements, but the most important was emphasizing the necessity for divorcing the laboratory from the stables, and obtaining purer air for the former. To that end the company began to look for a new site for laboratories and stables in the country, and

all of us began to draw plans for new and improved laboratory arrangements. However, things continued pretty much the same and we were obliged to work in the same place for several years.

After two years John Adams left us and E. V. Ranck became the veterinarian. Robert L. Pitfield was added to the staff as a research worker with special reference to a prophylactic for hog cholera. As all that he did was under the then prevalent idea that the *Bacillus suipestifer* was the cause of the disease, our failure can be understood.

To the diphtheria antitoxin we added other preparations such as tetanus antitoxin and tuberculin. Having gallons of the latter, it was but a step to make an "anti-tuberculin" which when tried on guinea-pigs seemed to have some protective value. We also tried "anti-venene," though never able to obtain a serum potent enough to promise usefulness in the doses in which it could be administered. Anti-streptococcic and anti-pneumococcic serums were also tried, and our experience with the latter was as interesting as it seemed paradoxical. It was very important to have the serum tested clinically and that James C. Wilson consented to do. A supply was sent to the German Hospital, where it was administered to pneumonics with glittering results. A crisis was quickly precipitated and each patient in the series recovered. Wilson was delighted and we were jubilant. A new consignment was, at his request, sent to the Pennsylvania Hospital where it was used with the melancholy outcome that more cases died under treatment with the serum than without it. As this was openly announced it undid our further efforts to combat pneumonia, and it was not until many years later, when the various types of pneumococci had been separated, that the paradox could be understood.

The rattlesnakes that furnished the venom for the experiments with antivenom serum were kept in an alcove adjoining the small animal room in boxes covered with wire netting. In the latter there was always more or less loose hay on the floor, and twice daily a large handful of it was placed in each of the hundred or more open top guinea-pig boxes. Imagine the consternation that ensued one day when it was discovered that a snake-box had been left open by a careless boy employed to feed the animals, and that the rattlesnake it had contained had escaped! Where to look for it in a room full of boxes

of hay in a stable was a momentous question. Fortunately the snake, a large one, was shortly seen coiled and asleep in the sunshine that fell upon the top of a neighboring box, and was returned to its apartment. For some time thereafter the "diener" brought in the guinea-pigs in fear and trembling, lest there be another escaped snake!

With fifty or more horses down stairs, it may be imagined that the atmosphere of the laboratory was redolent with the odor of stable. As we began our activities in the pleasant months of autumn, when all of the windows were open, no attention was paid to the matter, but as the temperature fell and the winter cold necessitated the closure of the windows and sometimes made us shiver about a stove in the center of the laboratory, the ammoniacal odor penetrated everywhere, and we soon discovered that we carried it away in our clothing in such concentration as to offend the olfactories of those beside whom we travelled in the street cars and trains.

It became necessary to hire a room in a private house, near by, in order to change clothing before going to the laboratory and after leaving it. Even with this precaution we carried the odor about with us in our underclothing and in our hair, to the distress of our families and surprise (disgust?) of our friends.

Life in this establishment where we worked with diphtheria, tetanus, anthrax, venoms, hog-cholera, pneumonia and other dangerous maladies was full of thrills, and only eternal vigilance saved us and the public from disaster.

As Pitfield's practice became more exacting he was less able to devote time to this laboratory and resigned about 1898 to be succeeded by Arthur P. Hitchens, now Major Hitchens of the U. S. Army.

The Company at length decided to remove to a location at Glenolden Station, on the Philadelphia, Wilmington and Baltimore branch of the Pennsylvania Railroad, where they bought a tract of several acres and proceeded to erect a group of fine laboratory buildings that should overcome every objection already experienced and provide abundant space for future expansion.

It now became necessary for the members of the staff to decide whether they should devote themselves exclusively to commercial bacteriology or not. I had, in 1896, been elected Professor of

Pathology and Bacteriology in the Medico-Chirurgical College, so I decided upon institutional and educational work as my calling and resigned in 1900, leaving Clarence W. Lincoln to fill the interim until J. J. Kinyoun of the United States Public Health Service should come to take charge in the new and now completely finished and equipped laboratories at Glenolden.

VI. The Philadelphia Authors of Books on Bacteriology

The first Philadelphia book upon the subject was M. V. Ball's "Essentials of Bacteriology," W. B. Saunders Company, Philadelphia, 1891. It is interesting that a book on so new a subject, and a book of such excellence as to hold its market for many years should have resulted from an order given by a publisher to an unknown but gifted young man.

Michael V. Ball was born in Warren, Pennsylvania, February 14, 1868 and was graduated M. D. from Jefferson Medical College in 1889. During the years from 1886-1889 that he was a student, no bacteriology was taught in that institution, but "on one occasion Jacob M. DaCosta introduced to the class a young physician—Julius Salinger—just returned from Berlin, who made a drawing of the "comma bacillus" (cholera spirillum) on the blackboard."

Having taken the Henry C. Lea prize of one hundred dollars for an essay upon "The Action of Naphthalin on the Urine," Ball decided upon a trip abroad and visited the Paris Exposition of 1889, and spent more or less time in various clinics in London, Paris, Copenhagen and Berlin. As he spoke German fluently he spent the most time in Berlin where he pursued a "Bakteriologisches Kursus" given at the Hygienisches Institut by Robert Koch assisted by Carl Fraenkel and Emil Behring. This course lasted for four weeks, ten hours a day. Ball, aged twenty-one years, was the only student from the United States of America, and worked among older men from Greece, Turkey, South America, Africa, etc., from January first to January thirty-first, 1890. Returning to Philadelphia in April 1890, he became an interne at the German Hospital. Believing that a good book on bacteriology in the English language was needed, Ball wrote to Carl Fraenkel asking for authority to translate his "Grundriss der Bakterienkunde" but found that it had already been conferred upon a New York publisher.

About the same time he made the acquaintance of a young Philadelphia publisher, W. B. Saunders, who was making a specialty of a new type of student's book known as "Question Compends" in which the matter was arranged in the form of questions and answers.

After considerable discussion, a contract for the manuscript was signed

M. V. Ball

Robert L. Pitfield

January 16, 1891, while the prospective author was still an interne at the German Hospital, the emolument to be one hundred dollars in full settlement, and the work completed by July first of the same year. Shortly afterward came a chance to become ship's surgeon on a Red Star Liner, that was eagerly seized, and while at sea, with but little to do, and few distractions to interrupt his work, the manuscript was completed and the "Essentials of Bacteriology" published in October 1891.

The book was very small, only about five by seven inches, the first edition containing only one hundred and fifty-nine pages including the index. The question and answer form was not used, the text being continuous. Only about sixty pages were devoted to pathogenic microorganisms, the rest of the space being devoted to technic, non-pathogenic bacteria and other higher fungi. The little book at once became popular and went through six editions by 1908. In 1913 an enlarged seventh edition appears under the conjoint authorship of M. V. Ball and Paul Weston.

A year later another small book, "The Principles of Bacteriology; a practical Manual for Students and Physicians," 263 pp., 8°, Philadelphia, Lea Brothers and Company, 1892, by Alexander C. Abbott, made its appearance.

A biographical sketch of the author is given in connection with the account of the Laboratory of Hygiene of the University of Pennsylvania. The book lived for more than forty years, appearing in edition after edition. In the beginning it may have fulfilled the requirements of the newly instituted brief courses in bacteriology that were being offered by institutions of learning throughout the country, but as the years and decades passed and the subject grew, it lost value with each new edition, yet for some mysterious reason the new editions continued to appear. It is to be deplored that Abbott did not improve his book so as to make and keep it abreast of the times as long as he lived.

"The Pathogenic Bacteria," a Text-book for Students of Medicine and Physicians, was written by Joseph McFarland, and published by W. B. Saunders Company, Philadelphia, 1896. It was more ambitious than the books that had preceded it, and took and held a field of its own for thirty years, for many years being the text-book most used in American and English Medical Schools. It

passed through nine editions, each larger than the other, eventually having its title changed to " Pathogenic Bacteria and Protozoa." The ninth and last edition made its appearance in 1919 and had 858 pages including the elaborate indices.

Long before, the author had been compelled to devote himself more and more exclusively to Pathology, and less and less to Bacteriology, until the rapid advances made it impossible for him any longer to keep up, the book suffered and was dropped.

Alexander C. Abbott tried his hand at authorship a second time in 1899 and turned out another small book, " The Hygiene of Transmissible Diseases," W. B. Saunders Company, Philadelphia, 311 pp. This was a kind of combination hygiene and bacteriology, in which were said again and in slightly different form what had been previously said in the " Principles of Bacteriology." A second, somewhat improved second edition appeared in 1901, but the book met with little success and had a short life.

The year 1907 saw the arrival of a new little book of the " Quiz-Compend " type—" A Compend on Bacteriology including Animal Parasites," by Robert Lucas Pitfield, P. Blakiston's Son and Company, Philadelphia, 1907, 220 pp. It found a place at once, reached and maintained a certain degree of popularity and is still a living book. When it came time for the appearance of the fifth edition in 1930, Pitfield turned it over to Howard W. Schaeffer and relinquished his future rights to the book.

Robert Lucas Pitfield was born at Germantown, Philadelphia, February 28th, 1870. He received his preliminary education at the Germantown Friends School and at the Westtown School, West Chester, Pennsylvania. His medical studies were pursued at the University of Pennsylvania, where he was graduated M. D. in 1892. He was a resident physician at the Germantown Hospital, upon leaving which he became associated with McFarland in the laboratory of the H. K. Mulford Company, as a special research assistant, and subsequently as Demonstrator of Bacteriology in the Medico-Chirurgical College 1902-4.

The accomplishment for which Pitfield will probably be longest remembered is his excellent method of staining bacterial flagella.

Two other books upon bacteriology, written by Philadelphia authors, must be mentioned although they made their appearance much later:

" Bergey's Manual of Determinative Bacteriology: A Key for the Identification of Organisms of the Class Schizomycetes," arranged by a committee of the Society of American Bacteriologists, David H. Bergey, chairman, Francis C. Harrison, Robert S. Breed, Bernard W. Hammer and Frank M. Huntoon. Baltimore, Williams and Wilkins Company, 1923, 442 pp., 8°.

The greater part of such a work naturally falls upon the chairman of the committee, and it is only just that this book appeared as Bergey's Manual. All of Bergey's friends are acquainted with the elaborate literary research, the careful card-indexing and cross referencing, the comparison and weighing of the thousands of descriptions of microorganisms that constituted the preliminary step to the consummation of this important and now indispensable book. It has relegated to the scrap-heap all of its predecessors and clearly explains the basis of classification and nomenclature of the schizomycetes, and tabulates those characters by which their place in the system is to be found. It is undoubtedly the most important of the modern toxonomic works.

In January and February, 1921, the Richard B. Westbrook Free Lectureship of the Wagner Free Institute of Science of Philadelphia, invited McFarland to give a course of lectures upon " some phase of Microbiology," to be popular and yet scientifically accurate, the lectures subsequently to be printed in some form. The notes of these lectures amplified and improved constituted the manuscript of a book: " Fighting Foes too Small to See," by Joseph McFarland, M. D., Philadelphia, F. A. Davis Company, 1924, 8°, 300 pp. It is a continuous narrative of the discoveries of microbiology and their application to sanitary science, the objective of which was to make clear to the lecture audiences and later to the readers of the book what the Health Authorities are driving at when they insist upon compulsory vaccination, the notification of contagious diseases and the placarding of houses, the extermination of rats, the draining of

swamps, delousing and fumigation, by showing the evolution of knowledge that gradually led up to them.

The "Practical Text-book of Infection, Immunity and Specific Therapy," by John A. Kolmer, M. D., Ph. D., was published by W. B. Saunders Company, Philadelphia, in 1915, and must be mentioned as one of the most notable of the Philadelphia productions. A large book of 899 pages, it has become a vade mecum in many laboratories, and is known the world over.

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MEDICO-HISTORICAL ACTIVITIES IN THE UNITED STATES

NATIONAL

The History of Science Society

The History of Science Society held its 13th annual meeting at Brown University in Providence, Rhode Island, on Wednesday, December 30, 1936.

In a joint session with the American Historical Association the following papers were read:

President's Address: The Evil Science Does
Chauncey D. Leake, University of California

John Howard and the Public Health Movement
Leona Baumgartner, New York Hospital

New Light on Reverend Thomas Thacher's *A Brief Rule* (1677-78). the First Medical Document to be Published in this Country
Henry R. Viets, Boston, Massachusetts

The History and Work of the Army Medical Library. (Illustrated)
Major Edgar Erskine Hume, Carlisle Barracks, Pennsylvania

Scientific Glossaries in Sixteenth Century English Books
Sanford V. Larkey, Johns Hopkins University

Bartholemo Montagnana's *Consilia* (1476)
Arnold C. Klebs, Nyon, Switzerland

On December 31st a session of the Bibliographical Society of America was held during which the following papers concerning the history of science were read:

Present Status of a New Bibliography of Incunabula of Science and Medicine
Arnold C. Klebs, Nyon, Switzerland

A New Bibliography of Joseph Priestly, with Notes on His Scientific Writings
John F. Fulton, Yale University

NEW YORK

Cornell University College of Medicine, NEW YORK

"The Medical History Society of the Cornell Medical College is functioning successfully. It was decided to devote this year to early

American medicine. Two meetings have been held so far, the first for organization; at the second, two papers were presented by second-year students on *The Medicine of the American Indian.*

"All papers are given voluntarily, an informal discussion follows each paper, and refreshments are served at each meeting. There are no dues and no officers. Doctor Bruce Webster is presiding at the meetings and the program is arranged by a committee of one student from each of the four classes cooperating with Doctor Webster. We have been aided enthusiastically by the staff of the Library under Mrs. Nicholls."

SHEPARD GERARD ARONSON.

MARYLAND

University of Maryland, BALTIMORE

The Historical Society of the University of Maryland held a meeting in the "Chemical Hall" in the old University Building on Tuesday, January 19, 1937. The program was

Medicine in Baltimore in the early part of the nineteenth century and the organization of the University of Maryland

G. Carroll Lockhard and J. M. H. Rowland

H. E. S.